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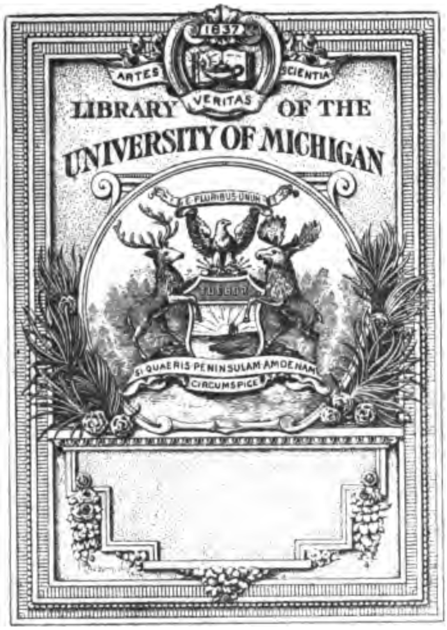
DRILL REGULATIONS
FOR
COAST ARTILLERY
UNITED STATES ARMY

1914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U. S. War dept.

WAR DEPARTMENT : OFFICE OF THE CHIEF OF STAFF

COAST ARTILLERY DRILL REGULATIONS

UNITED STATES ARMY

1914

WASHINGTON
GOVERNMENT PRINTING OFFICE
1914

WAR DEPARTMENT
Document No. 474
Office of the Chief of Staff

War Department,
Office of the Chief of Staff,
Washington, June 17, 1914.

These Drill Regulations have been approved by the Secretary of War and are published for the information and guidance of all concerned and for observance by the Coast Artillery Corps, United States Army, and by the coast artillery troops of the Organized Militia of the United States.

By order of the Secretary of War:

W. W. Wotherspoon,
Major General, Chief of Staff.

274393

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COAST ARTILLERY DRILL REGULATIONS, UNITED STATES ARMY.

Chapter I.

GENERAL PRINCIPLES.

1. The defense of a coast line involves the use of both naval and land forces.

2. The naval forces include:

(*a*) The active fleet, whose primary objective is the destruction of the enemy's fleet.

(*b*) That portion of the reserve fleet assigned to the local defense of a particular part of the coast.

(*c*) The naval coast patrol, which operates in conjunction with the shore signal stations.

The land forces include:

(*a*) The coast artillery troops, who are charged with the care and use of the fixed and movable elements of the seaward and landward defense of the coast fortifications, including guns, mortars, submarine mines, and torpedoes.

(*b*) The coast artillery supports, which consist of small bodies of coast artillery or mobile troops assigned to the defense of the fortifications against attack by raiding parties; they are under the orders of the coast defense commanders.

(*c*) The coast guard, which consists of a part of the mobile army concentrated at strategic points near the coast in position to oppose a landing in force by an enemy.

3. With reference to the land forces, the military preparations connected with the defense of the coast line may be divided into three groups, as follows:

(*a*) Constructing, arming, and equipping permanent fortifications and making provision for submarine defense.

(*b*) Constructing, arming, and equipping semipermanent fortifications and field works for the protection of the permanent fortifications against attack by small raiding parties on the landward side, or, in the case of an island, from boats from the adjacent shore.

(*c*) The organization and mobilization of mobile troops to resist the landing of large bodies of troops near cities and fortified harbors and for the defense of strong semipermanent works on interior lines. These troops are known as coast guards. The coast guard commander is an officer of the mobile army, and, while entirely independent of the coast defense commander, should cooperate with him.

In addition to the foregoing, divisions and field armies may be concentrated and held at strategic centers of value with reference to the whole coast line.

4. The armament employed in coast defenses consists of the fixed armament emplaced in permanent batteries and the movable armament for use in the landward defense of the permanent batteries.

5. The fixed armament is classified as major, intermediate, and minor, depending on the caliber.

6. The major armament consists of guns of 8-inch or greater caliber and of 12-inch mortars. The guns of the major armament employ direct fire, and are designed for attacking the sides and other vertical armor of armored vessels. Shot and shell are used with these guns. Shot are used at shorter ranges where perforation of the main armor is possible, and are intended to reach the interior of a ship before explosion. Shell are used at the longer ranges to perforate or rack armor, injure unarmored parts, cause casualties among the personnel, and to destroy or impair the serviceability of fire control installations. The mortars use high-angle fire and are designed for attacking the decks of armored vessels.

7. The intermediate armament consists of 6-inch and 5-inch guns. These guns are designed for attacking unarmored vessels and the unarmored parts of armored ships, supplementing the fire of the major armament.

8. The minor armament consists of 3-inch, 4-inch, and 4.7-inch guns. These guns are designed for the defense of the mine fields and for supplementing the intermediate armament in the attack on unarmored vessels.

9. As applied to a coast artillery command, the movable armament consists of the field and siege guns, siege howitzers and mortars, and the machine guns, assigned to the command. The movable armament is primarily intended for landward defense, but portions thereof may be assigned, when desirable, to supplement the fire of the minor armament in seaward action.

10. The mine defense of any harbor consists of all mine matériel and mine personnel pertaining to that harbor, together with all battery commands assigned to protect the mine field. In addition to the mines proper, the mine matériel includes among other things mining casemates, storehouses, loading rooms, cable tanks, boats assigned to the mine defense, position-finding service for the mine fields, and the mine field searchlights.

11. As applied to a coast artillery command, the service of security is closely allied with the service of information. Both are accomplished by (*a*) cooperation with the Navy, (*b*) through the activities of small vessels employed as scouts, and (*c*) through observation on the part of the fort commands, the fire commands observing principally the seaward approaches, and the support commands the landward approaches. Units of the aviation corps, when available, are utilized for the service of security and information for both landward and seaward approaches.

12. The units of the tactical chain of coast artillery command are the battery command, the fire command, the mine command, the support command, the fort command, and the coast defense command, as shown in the following diagram:

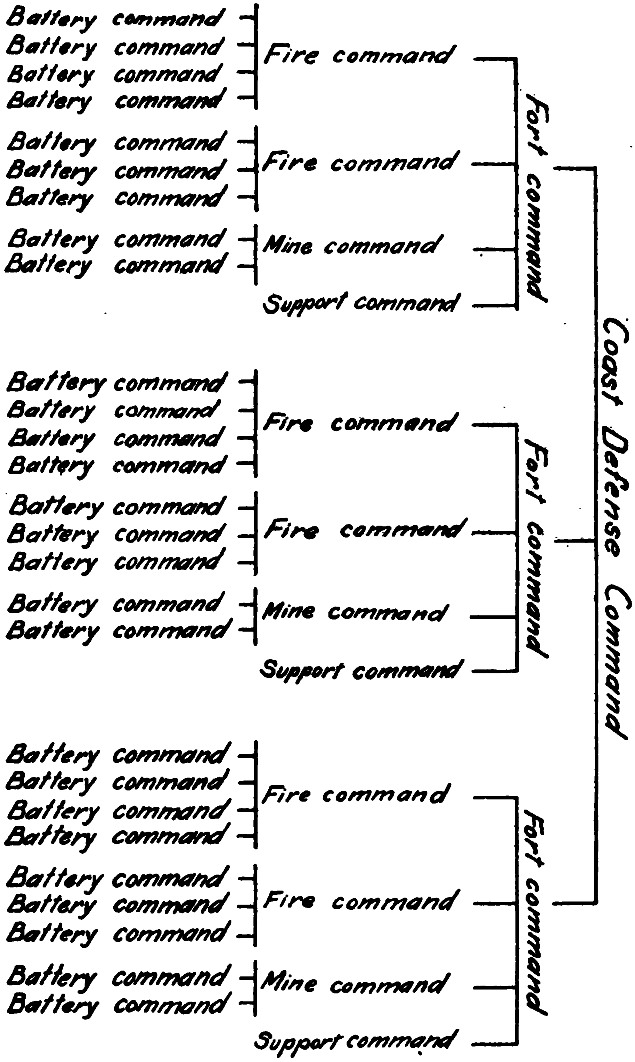

Battery command
Battery command
Battery command
Battery command
Fire command
Battery command
Battery command
Battery command
Fire command
Battery command
Battery command
Mine command
Support command
Fort command
Battery command
Battery command
Battery command
Battery command
Fire command
Battery command
Battery command
Battery command
Fire command
Battery command
Battery command
Mine command
Support command
Fort command
Battery command
Battery command
Battery command
Battery command
Fire command
Battery command
Battery command
Battery command
Fire command
Battery command
Battery command
Mine command
Support command
Fort command
Coast Defense Command

FIG. I.

13. **A battery command** consists of one or more guns or mortars commanded directly by a single individual, together with all structures, equipment, and personnel necessary for their emplacement, protection, and service. The senior officer present for duty is the battery commander.

14. **A fire command** consists of two or more battery commands, the additional fire control stations and accessories, and the personnel assigned to the fire command. The senior officer present for duty is the fire commander.

If practicable, mortar battery commands will not be grouped with gun battery commands in the same fire command, nor will battery commands of the major armament be grouped with those of the intermediate or minor armament.

15. **A mine command** consists of such portion of the mine defense as can be controlled advantageously by a single individual. The senior officer present for duty is the mine commander.

16. **A support command** consists of the personnel and matériel of the coast artillery supports pertaining to one fort and of their defensive works and positions. The senior line officer present for duty with the coast artillery supports is the support commander.

17. **A fort command** consists of all the means of seaward and landward defense, including both personnel and matériel, located at any coast artillery fort. Unless otherwise directed by the Secretary of War, the senior coast artillery officer present for duty, other than the coast defense commander and his staff, is the fort commander.

18. **A coast defense command** consists of a group of fort commands provided for the defense of a harbor or point of the coast. The senior coast artillery officer present for duty is the coast defense commander.

Chapter II.

ASSIGNMENT OF PERSONNEL.

19. The smallest administrative unit of the Coast Artillery Corps is the company. The law contemplates that its size shall be adjusted to the manning requirements of the particular battery or mine command to which it may be assigned. Coast artillery companies, therefore, vary in size and are to be considered as manning bodies of the gun, mortar, and mine elements of the coast defenses.

20. Coast artillery companies will be assigned to the service of guns, mortars, or mines by War Department orders; they will be assigned to particular batteries or mine commands by coast defense commanders.

21. As a rule, gun and mortar companies will be assigned so as to place the maximum number of fire commands in service.

22. A gun company will be divided into sections as follows: One range section, and for each emplacement, one gun section. The sections will be subdivided into detachments and details for manning the matériel to which assigned.

23. A mortar company will be divided into sections as follows: One range section, and for each pit, one pit section. The sections will be subdivided into detachments and details for manning the matériel to which assigned.

24. A mine company will be divided into sections as follows: One planting and loading section, one range and power section; and for each emplacement manned, one gun section. Members of the planting and loading section may also be assigned to gun sections, since in general the service of the latter will not take place simultaneously with that of the former. Sections will be subdivided into detachments and details for manning the matériel to which assigned.

25. The senior noncommissioned officer of each section, detachment, or detail is its chief. Each chief will command his subdivision and will be responsible for its drill, its efficiency, and the condition of the matériel to which it is assigned.

26. Manning tables for the armament and its accessories will be made out and posted in each coast defense command and will indicate accurately the precise individual assignments as follows of officers and men on duty:

In each coast defense headquarters:

(*a*) For the coast defense commander's headquarters.
(*b*) For the signal stations.
(*c*) For the boats assigned to the coast defense command.

In each fort commander's station:
- (*a*) For the fort commander's station.
- (*b*) For each searchlight.
- (*c*) For each power plant or station.
- (*d*) For the signal stations.
- (*e*) For the fort switchboard.
- (*f*) For the boats assigned to the fort command.
- (*g*) For the meteorological station.
- (*h*) For the tide station.

In each support commander's headquarters:
- For each element of the landward defense.

In each fire commander's station:
- (*a*) For the fire commander's stations.
- (*b*) For each power station.
- (*c*) For each searchlight assigned to the fire command.

In each mine commander's station:
- (*a*) For the mine commander's stations.
- (*b*) For each searchlight assigned to the mine command.
- (*c*) For each planting and loading section.
- (*d*) For each battery section.
- (*e*) For each range and power section.

In each gun battery commander's station:
- (*a*) For the range section.
- (*b*) For the gun sections.

In each mortar battery commander's station:
- (*a*) For the range section.
- (*b*) For each pit section.

27. Details for the manning table specified in the preceding paragraph will be made as follows:

For a coast defense, fort, support, fire, mine, or battery command, by the coast defense, fort, support, fire, mine, or battery commander, respectively.

28. Company commanders will be required by fort commanders to keep men trained for each position of the manning bodies for fire, mine, and fort commanders' stations for which they furnish details, including an adequate reserve for the more important positions.

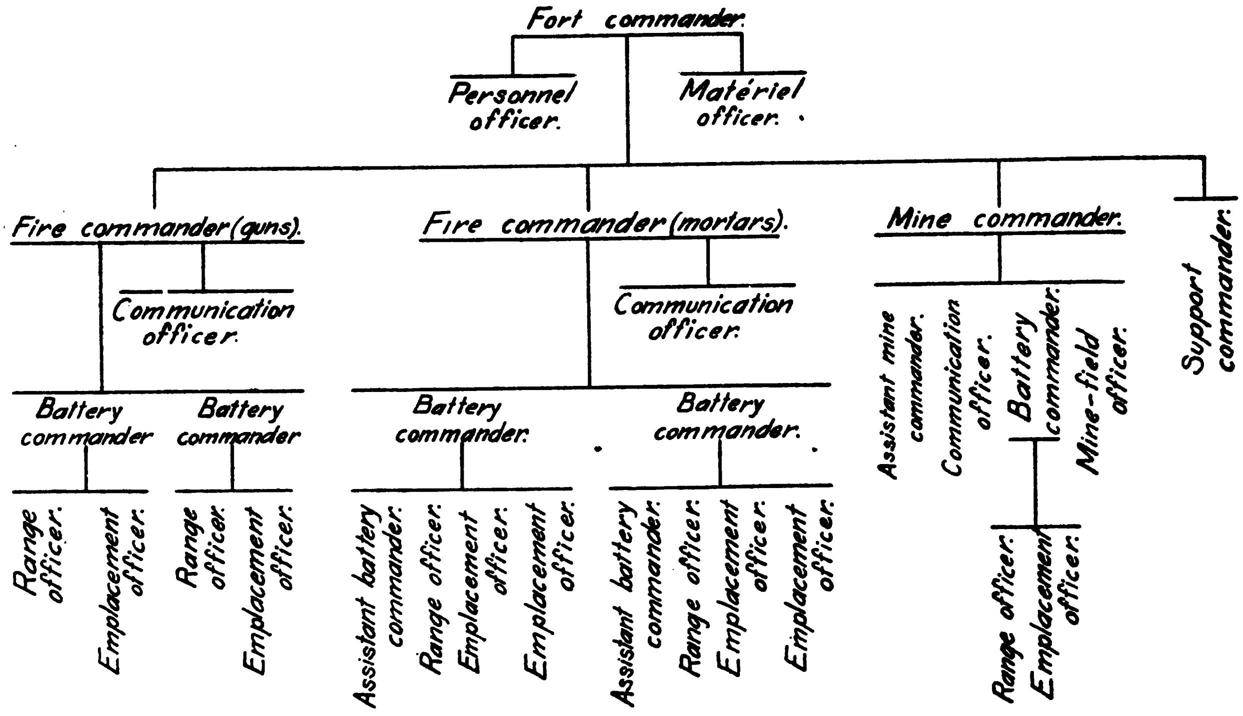
29. In the barracks of each company, a manning table will be kept showing the assignment of each member of the company. Men excused from artillery drill will be given an assignment on this manning table. It will show also those trained and designated for service in fire, mine, and fort commanders' stations.

30. Figure 2 illustrates the relations to each other of the officers of a fort command.

31. Coast defense and fort commanders will be assigned by War Department orders. During the absence of regularly assigned coast defense or fort commanders, the senior coast artillery officers present for duty will perform the duties pertaining to those offices as provided in paragraphs 17 and 18.

32. Fire commanders, mine commanders, and staff officers will be assigned by the coast defense commander. The senior fire commander will be assigned to that fire command which will best

FIG. 2.


Fort commander.
Personnel officer.
Matériel officer.
Fire commander (guns).
Communication officer.
Battery commander
Range officer.
Emplacement officer.
Battery commander
Range officer.
Emplacement officer.
Fire commander (mortars).
Communication officer.
Battery commander.
Assistant battery commander.
Range officer.
Emplacement officer.
Emplacement officer.
Battery commander.
Assistant battery commander.
Range officer.
Emplacement officer.
Emplacement officer.
Mine commander.
Assistant mine commander.
Communication officer.
Battery commander.
Range officer.
Emplacement officer.
Mine-field officer.
Support commander.

permit him to succeed, in case of emergency, to the command of the fort command.

33. Officers other than staff officers will not be detailed as communication officers if such details will reduce the number of officers present with a battery command to less than that required by its manning table. If no officer is available, a suitable noncommissioned officer (preferably a sergeant major) will be designated to act as communication officer.

34. Mine commanders will assign the officers of the companies of the mine command in accordance with their special fitness.

35. Battery commanders will assign the officers of their commands in accordance with their special fitness.

36. In general, the officer next in rank to the battery commander will be assigned to a station or duty which will permit of his succeeding to command without delay or confusion. When the plotting room is adjacent to the battery commander's station, the battery commander of a gun battery command may assign both lieutenants as emplacement officers.

Chapter III.

COMPANY FORMATIONS AND MARCHING MANEUVERS.

37. To form the company.

Normally a company will be formed for drill or inspection on its company parade and marched to its battery or station, but when in camp at the battery or when quartered in close proximity to the battery, may form on the battery parade.

To form the company, the first sergeant takes post 6 paces in front of where the center of the company is to rest and, facing that point, commands **FALL IN.**

Each chief of section takes post 3 paces in front of where the center of his section is to rest and, facing the section, superintends the formation of his section.

Each section assembles in two ranks with 4 inches between files and with 40 inches between ranks. Detachments and details form in order from the right according to the drill of the piece or apparatus to which assigned. Chiefs of detachments take posts in the front rank on the right of their respective detachments and are not covered by rear rank files. Chiefs of details take post in the front rank of the right of their respective details and are covered in the rear rank by the lowest odd number of the detail. Men not assigned to detachments or details assemble in the line of file closers.

Sections are formed in order from right to left as follows:

For a gun company: Range section and gun sections (first, second, third, fourth, etc.).

For a mortar company: Range section and pit sections (first, second, etc.).

For a mine company: Planting and loading section, range and power section, and gun sections (one for each emplacement manned).

An interval of 4 paces is left between sections (not considering the chiefs of sections).

Musicians form on line with the front rank 8 paces from the right of the first section (not considering the chief of section).

Mechanics or acting mechanics take posts in the front rank on the left of their respective sections.

The sections having been formed, the first sergeant commands **CALL ROLLS.** Each chief of section calls his roll and faces about. The first sergeant then commands **REPORT,** and each chief of section in turn from the right salutes and reports "——— section present" (or names of unauthorized absentees) and takes post in the front rank 1 pace from the right of his section.

The first sergeant having received the reports of the chiefs of sections commands **CALL OFF**. At this command each section calls off from right to left, the odd numbers in the rear rank, the chiefs of details and the even numbers in the front rank.

The first sergeant then faces about, salutes, and reports to the company commander, who has taken his post 12 paces in front of and facing the center of the company. The first sergeant then takes post on line with the front rank and 4 paces from the first section (not considering the chief of section).

When the first sergeant starts toward his post, the officers other than the company commander form in line 6 paces in front of the company, facing to the front, each officer opposite the center of that half of the company which contains all or most of the sections which he supervises at drill (thus a range officer of a gun or mortar company takes post opposite the center of the right half of the company).

When there are more than three officers on duty with a company, the additional officers take posts in line with the other officers in positions designated by the company commander.

38. Inspection (artillery) in ranks.

The company having been formed, the company commander commands **OPEN RANKS, MARCH.**

At the command **MARCH** the front rank executes right dress; the rear rank and file closers march backward 4 steps, halt, and execute right dress. The company commander aligns the front rank from a position just to the right of the chief of the first section. He then moves straight to the rear and aligns the rear rank and file closers, and then takes post 6 paces in front of the chief of the first section, facing to the left, and commands **FRONT**.

Having inspected the officers, the company commander, accompanied by the officers, inspects each rank and line of file closers from right to left in front, and from left to right in rear. When the inspection is completed, the officers resume their posts, the company commander taking post 12 paces in front of the center of the company. From this position he commands **CLOSE RANKS, MARCH.**

Should the inspector be other than the company commander, the latter, after commanding **FRONT**, adds **REST**, and faces to the front. When the inspector approaches, the company commander faces to the left, brings the company to attention, faces to the front, salutes, and accompanies the inspector.

39. To march the company to its battery or station.

The company is formed in column for marching by the command of the company commander, **RIGHT FACE**. At the second command the officer on the right takes position on the left of and one pace from the chief of the first section; the officer on the left takes post on the left of and one pace from the chief of the rear section; all in ranks face to the right; the musician who is in rear after facing, steps up to the right of the musician in front of him; the company commander faces to his left.

The company in column is marched, halted, and direction changed as prescribed for a column of files in Infantry Drill Regulations, except that in marching, the column extends to easy marching distance without command, and in halting, all close up to facing distance without command. The company commander marches in such position as will enable him best to direct the movements of the column.

40. To post the sections.

The company commander marches his company to its battery or station, and as he approaches the battery or station commands **SECTIONS POSTS.** At the second command each chief of section falls out of ranks, marches his section to a point near its emplacement or station, and commands **DETAILS POSTS.** At the second command all details fall out, procure equipments and implements, and take their posts.

Each chief of section determines whether all apparatus and material to be served by his section is in order, and reports to the officer directly over him, "Sir ——— in order" or reports defects he is unable to remedy without delay. As soon as the chiefs of section have reported, the officers report to the battery commander, who then reports to the fire commander "——— in order" (inserting name of battery), or reports defects he is unable to remedy without delay. (The reports from mine companies are made to the mine commander.)

If he so desire, a company commander may post the sections separately, at any point of the march, by commanding: ——— **SECTION, POST.** The section designated is posted as described above.

When a range section leaves the column, the range officer falls out and proceeds direct to his station.

Details for remote stations may be marched to their stations from the company parade by their respective chiefs.

41. To dismiss the sections.

Battery commanders command **DISMISSED.** Range officers command **CLOSE STATION** (or **CLOSE STATIONS**). Emplacement officers command **REPLACE EQUIPMENTS.** Chiefs of sections command **FORM SECTION.** The company is formed on the battery parade and is marched by the battery commander to the company parade and dismissed.

Subdivisions from remote stations are marched to the company parade and dismissed by their chiefs.

42. To form as infantry.

To form for infantry drill or exercises under arms, the files fall in with the pieces at "Order." The chiefs of section salute and report with their pieces at "Order" and move to their posts with their pieces at "Trail," coming to "Order" upon halting. The first sergeant draws saber (if armed with one) before giving the command to fall in. After receiving the reports of the chiefs of section, he commands **INSPECTION ARMS, ORDER ARMS,** faces about, salutes, and reports to the company commander.

The company commander returns the salute and directs the first sergeant to form as infantry, whereupon the first sergeant faces about and forms the company as prescribed in Infantry Drill Regulations, except that squad leaders do not report and that corporals may be placed as Nos. 1 and 4 of the front rank when the reduced strength of the company makes it advisable. As soon as the company is formed properly, the first sergeant faces about, salutes, and reports to the company commander, "Sir, the company is formed." The company commander returns the salute and the first sergeant takes post. The company commander draws saber and takes his post facing to the front 3 paces in front of the center of the company.

Chapter IV.

THE BATTERY COMMAND.

THE BATTERY COMMANDER.

43. The battery commander will keep a record of the daily attendance at artillery drill in numbers only, showing separately those attending drill at the battery and those attending drill at stations not a part of the battery command.

44. The battery commander is responsible—

First. That the personnel of his battery command is smart and alert at drill and efficient in practice and action.

Second. That the equipment provided for his battery command is in serviceable and attractive condition and that no permanent modifications of equipment or prescribed methods are made without proper authority.

Third. That the officers and men of his battery command present a tidy appearance in ranks and at their posts and are instructed in the care, preservation, and use of artillery material as prescribed in these regulations and in orders.

Fourth. That the emplacement book and other records are kept as required by these regulations and by orders.

45. The battery commander will make every effort to keep his battery command supplied with the proper equipment, implements, and reserve ammunition.

46. The battery commander is not authorized to modify the drill as prescribed in these regulations, except as indicated hereinafter. If on account of local conditions it is necessary to modify the drill, it will be reported to the artillery district commander.

47. The coast defense commander, with the approval of the district commander, may authorize temporary changes in a provisional fire control installation.

48. Permanent changes in fire control installations (provisional or standard) or any changes in the standard installations will be made only upon authority of the Secretary of War.

49. If the battery commander improvises any device, method, or modification of the drill which in his opinion will increase the efficiency of his command, the coast defense commander may authorize such device, method, or drill to be tested during a limited specified period for a portion of the time allotted to daily artillery drill. If the result is favorable, a detailed report thereof will be made to the War Department, accompanied by drawings, and if practicable by models of devices used. The assistance of the proper staff officers of the coast defense command will, upon application, be given to battery commanders for the purpose of

constructing simple devices in accordance with their ideas, provided that no unauthorized expenditure of funds be involved. This paragraph will not be taken as authority for increasing the load upon any fortification plant without authority of the Secretary of War, nor of exemption from efficiency with the means and methods prescribed in these regulations.

50. Company commanders will keep range sections, telephone operators, and the details for fire, mine, and fort commanders' stations well instructed during both the indoor and outdoor periods.

51. Battery commanders will accompany the fort commander in his inspections of their respective battery commands.

52. In fort command or fire command drill or action, the battery commander's exercise of fire direction will be limited by orders which come to him from higher commanders. When **BATTERY COMMANDER'S ACTION** is ordered, or when communication with the fire and fort commanders is interrupted, he will exercise independent fire control and will fight his battery in accordance with the general plan of action.

53. At drill or in action, the battery commander will go wherever his presence is necessary, but upon quitting his station he will leave information as to where he may be found.

54. In case an observing station or any element of the position finding system goes out of action the battery commander will take the necessary steps to utilize to the best possible effect such elements of the position finding system as remain serviceable.

55. Battery commanders will improvise some method for the direction of the fire of their batteries, relying only upon stations located at the battery. In many cases where the channel is not wide, it will be practicable to determine the approximate ranges to ships of large size by azimuths alone.

56. Battery commanders will occasionally conduct drill and subcaliber practice under emergency conditions including the following:

(*a*) Elimination of primary station only.
(*b*) Elimination of secondary station only.
(*c*) Elimination of battery commander's station only.
(*d*) Elimination of primary and secondary.
(*e*) Elimination of primary and battery commander's station.
(*f*) Elimination of battery commander's station and secondary.
(*g*) Elimination of sight standard and gun pointer.

For mortars (*d*) and (*f*) will be omitted. An officer conducting the firing of a battery under any one of the emergency conditions specified above will not communicate with any station which is eliminated under that condition; he will get ranges from any instruments in any stations, except those that have been eliminated.

THE RANGE OFFICER.

57. The range officer is in charge of the position finding equipment and the range section of the battery command, and his station is at the battery plotting room. He is responsible to the battery commander for the condition of the matériel and for the efficiency of the personnel under his charge.

58. Before drill, practice, or action he will make a careful inspection of the equipment of his station, verifying the adjustments of the plotting board and of other apparatus.

59. Having completed the inspection, and having received the reports of the chiefs of details, he will report to the battery commander, "Sir, stations in order," or will report defects he is unable to remedy without delay. (See par. 40.)

60. At the conclusion of the exercises for the day he will direct that the stations be closed (par. 41), will inspect his station, and will report to the battery commander, handing him all records pertaining to the day's work at his station.

OBSERVERS.

61. Observers will be selected on account of their special aptitude. They will understand thoroughly the use of their instruments and will have a knowledge of the general characteristic features of war ships. Each observer is responsible for the care and adjustment of his instrument and for the police of his station at all times, and will report to the range officer deficiencies, defects, or accidental damages as soon as they are known.

62. Ranges to moving targets as determined by depression position finders and coincidence range finders will be compared frequently (if practicable) with ranges as determined by a long horizontal base.

63. Observers will be tested frequently as to their proficiency in the practical use of the instruments to which assigned. The test will be conducted so as to determine the relative ability of various observers to read quickly and accurately ranges to fixed and moving objects.

THE PLOTTER.

64. The plotter has charge of the plotting room under the range officer. He is responsible for the adjustment of the plotting board and other plotting room equipment. He will be tested frequently as to the accuracy of his prediction of set-forward points.

THE EMPLACEMENT OFFICER.

65. The emplacement officer is in charge of one or more emplacements. He is responsible to the battery commander for the condition of the emplacement matériel and for the efficiency of its service.

66. Before drill, practice, or action he will make a careful inspection of the matériel under his charge, and will test the electrical firing circuit if installed.

67. Having completed the inspection and having received the reports of the chiefs of sections, he will report to the battery commander, "Sir, Nos. ——— (or pit ———) in order," or will report defects he is unable to remedy without delay. (See par. 40.)

68. At the conclusion of the exercises for the day, he will command **REPLACE EQUIPMENTS** (par. 41), will inspect the emplacement, and will report to the battery commander.

THE GUN AND PIT COMMANDERS.

69. Each emplacement of a gun battery is commanded by a gun commander and each pit of a mortar battery by a pit commander, who is responsible to the emplacement officer for the condition of the matériel and the efficiency of the personnel of his section. The gun (or pit) commander will supervise the gun cleaning and will require the mechanic to keep pieces and carriages in excellent condition. He will supervise the service of the piece.

70. The gun (or pit) commander will have charge of the entire emplacement under the emplacement officer, and during the absence of the emplacement officer, he will perform the duties prescribed for the emplacement officer. After the details have been posted as prescribed in paragraph 40, he will command **EXAMINE GUN.** He will make a general inspection of the gun carriage, paying especial attention to the recoil cylinders, the firing device, and the oiling of the various bearings. He will report to the emplacement officer, "Sir, No. —— (or pit ——) in order," or will report defects he is unable to remedy without delay.

71. At the conclusion of the exercises for the day, he will command **FORM SECTION** after the emplacement officer has commanded **REPLACE EQUIPMENTS** (par. 41). He will supervise the replacing of equipments and implements, will see that the piece is secured, and will then form his section on the battery parade.

THE GUN POINTER.

72. A gun pointer is assigned to each gun in commission and is responsible for the condition and adjustment of the sight and sight standard. He will have a general knowledge of the characteristic features of warships. He will be tested frequently, as prescribed in paragraph 224.

THE MECHANIC.

73. One mechanic, or acting mechanic, is assigned, under the gun commander, to each 8-inch (or greater caliber) gun emplacement, to each mortar emplacement, and to each battery of the intermediate or minor armament in service. He is in immediate charge of all small stores and supplies at the emplacement or battery to which assigned.

Chapter V.

FIRE DIRECTION FOR BATTERIES OF THE MAJOR AND THE INTERMEDIATE ARMAMENT.

(For a description of the apparatus used in battery fire direction, see Chapter XXIII.)

74. The following systems of range and position finding are in use:

(*a*) The horizontal base system, which requires a station equipped with an azimuth reading instrument at each end of a horizontal base line. When a battery has more than one horizontal base line, those other than the normal base line are called auxiliary base lines. Auxiliary base lines may be obtained by using the observing instrument in the battery commander's station in connection with the instrument at B′ or B″.

(*b*) The vertical base system, which requires a single station equipped with a depression range and position finder.

(*c*) The coincidence range finding system, which requires a single station equipped with a coincidence range finder. If the coincidence range finder is not provided with an azimuth reading device, a separate azimuth instrument is required.

(*d*) The emergency system, which may consist of the systems specified in (*b*) or (*c*), or of some other system improvised by the battery commander.

75. The methods described below are based on standard installations. As far as applicable, they will be used with all installations. The fire direction for those batteries of the intermediate armament which are not provided with major armament equipment will be as prescribed for batteries of the minor armament in Chapter VI.

GUN BATTERY.

MANNING PARTIES.

76. Battery commander's station:
- Battery commander.
- Observer.
- Operator for each telephone.
- Musicians.

Plotting room:
- Range officer.
- Plotter.
- No. 1, assistant plotter.
- No. 2, primary arm setter.
- No. 3, secondary arm setter.
- No. 4, range board operator.
- No. 5, deflection board operator.
- No. 6, range transmitter.
- No. 7, operator for telephone to the emergency station.

Each observing station:
- Observer.
- Reader.

INDICATION AND IDENTIFICATION OF A TARGET.

77. The battery commander having identified a target, indicated to him by the fire commander, as prescribed in Chapter XVII, will indicate it to his observers (at B′, B″, B‴ and E) and gun pointers, as follows:

1. **TARGET**; 2. Subarea; 3. Name (or type and class) of an isolated ship, or designation of division, formation, ship number ———, and at night the number of the covering searchlight. When the observers are on the target they report "B′ (B″, B‴ or emergency) **ON TARGET.**" When the gun pointers are on the target, they report "No. 1, 2, 3, or 4 on target." When the battery commander is satisfied that the target has been correctly identified by the observers, he will give the command 4. **TRACK.** Unless otherwise specified, the system normally used at the battery will be used at the command **TRACK.**

78. Some examples of commands are as follows (dashes indicate pauses to allow for transmission of the command by telephone):

1. **TARGET** ———; 2. **OCEAN VIEW** ———; 3. **TEXAS** (observers report B′, B″, B‴, or emergency on target; gun pointers report No. 1, 2, 3, or 4 on target). 4. **TRACK.**

1. **TARGET** ———; 2. **LYNNHAVEN** ———; 3. **OIL TANK CLASS 1–3** (observers report B′, B″, B‴, or emergency on target. Gun pointers report No. 1, 2, 3, or 4 on target.) ———; 4. B′ (or B″) **VERTICAL BASE, TRACK.**

1, **TARGET** ———; 2. **BOCA CHICA** ———; 3. **MONITOR DIVISION** (observers report B′, B″, B‴, or emergency on target. Gun pointers report No. 1, 2, 3, or 4 on target.) ———; 4, B′ (or B″) **AUXILIARY BASE, TRACK.**

1, **TARGET** ———; 2. **TOBOGA** ———; 3. **DESTROYER DIVISION, SHIP NO. 1.** (Observers report B′, B″, B‴, or emergency on target. Gun pointers report No. 1, 2, 3, or 4, on target) ———. 4. **EMERGENCY SYSTEM, TRACK.**

79. Observing and aiming points for observers and gun pointers will be as follows:

1. For all power vessels having but one funnel, that funnel will be the observing and aiming point.
2. For all sailing vessels having but one mast, that mast will be used for the observing and aiming point.
3. For all power vessels having two or more funnels, the forward funnel will be the observing and aiming point.
4. For all sailing vessels having two or more masts, the forward mast will be the observing and aiming point.
5. For all vessels not included above, the aiming point will be designated by the commander assigning the target.

If for any reason it is impracticable to utilize the observing and and aiming points specified above, the battery commander will designate other points when he indicates the target, or at any time after he indicates the target that it becomes impracticable to use the prescribed points.

HORIZONTAL BASE SYSTEM.

30. The command **TRACK** having been given by the battery commander, each observer follows the target. At the first stroke of the time interval bell, he moves his instrument in azimuth so as to place the vertical wire accurately on the observing point, keeps it there until the third stroke of the bell, and stops the instrument precisely on the third stroke. The reader at each station reads the azimuth and transmits it to the proper arm setter. When for any reason the observing interval is not indicated by bell, the stop watch is used, and the commands **READY**, **TAKE** are given over the observer's line from the battery commander's station. (**READY** corresponds to the first stroke of the bell, and **TAKE** to the third stroke.) The tracking continues until **CEASE TRACKING** or **CHANGE TARGET** is ordered.

No. 2 wears a telephone head set on line from B′. He sets the primary arm to the azimuth received from B′ and calls "set."

No. 3 wears a telephone head set on line from B″. He sets the secondary arm to the azimuth received from B″ and calls "set."

The plotter places the targ accurately at the intersection of the arms and marks on the plotting board the position of the plotted point. When more than one point on a course has been plotted, he calls **CLEAR**, or gives a signal as soon as he has marked each new point. At this command or signal, the arm setters move their arms so as to clear the track of the target. The plotter considers the plotted track of the target and the probable course of the target, and using a prediction ruler (or other form of predicter) he marks the position of the set-forward point on the board so that it will lie on the probable track of the target. The plotter then swings the gun arm to the set-forward point and reads off the gun arm the *actual* range to the set-forward point (the gun arm must be set at normal). He then moves the gun arm to the last plotted point and holds it there until No. 1 reads the angular travel and resets the tally dial and the tally subdial. (If there is considerable lost motion in the tally dial the plotter should first move the gun arm to the plotted position before the last, hold it there until No. 1 sets the tally dial and the tally subdial, then move the gun arm to the last plotted position and hold it there while No. 1 reads the angular travel.) Angular travel may be taken between set-forward points, but the result is not as accurate as when taken between plotted points. When travel is taken between set-forward points, No. 1 calls off the angular travel as soon as the plotter has called the range, and resets the tally dial and the tally subdial.

To set the tally dial and the tally subdial, No. 1 turns the outer scale of the tally subdial until the zero is opposite the pointer, and sets the disk of the tally dial so that the 15 of the scale is opposite the pointer. No. 1 calls out the reference number corresponding to the angular travel of the target to No. 5, reading the degrees from the tally dial and the hundredths from the outer scale of the tally subdial. No. 1 operates the wind component indicator and sets the target arm to the azimuth of the gun arm, changing it whenever the azimuth of the gun arm changes as much as 2½°. The azimuth and the velocity of the wind are received by telephone.

When Case III is used, No. 1 calls off the azimuth of the set-forward point.

No. 4 wears a telephone head set on the line to the emplacements. He operates the range board and the atmosphere slide rule. By means of the atmosphere slide rule, he determines (from the barometer and the thermometer readings which are telephoned to the station) the atmosphere reference number. He obtains the wind reference number from No. 1, who operates the wind component indicator. The height of tide is telephoned to the station. The battery commander or the range officer specifies the muzzle velocity to be used on the range board.

No. 4 sets the ruler to the actual range of the set-forward point as called off by the plotter, and after applying corrections for atmosphere, wind, tide, and velocity, he telephones the corrected range of the set-forward point to the emplacements. He sends to the guns, the deflection called by No. 5 in Case II or the azimuth called by No. 1 in Case III.

No. 5 operates the deflection board. He uses the angular travel called off by No. 1 and takes the wind reference number from the wind component indicator, which is operated by No. 1. He applies the corrections for wind, drift, and angular travel of the target in Cases I and II, and calls the sight deflection to No. 4. In Case III he determines the corrections for wind and drift and then applies the resultant correction to the azimuth correction scale of the gun arm whenever it differs from the previous correction by 0.05 or more.

No. 6 transmits to the guns by means of the mechanical or electrical range transmitter the corrected range announced by No. 4.

VERTICAL-BASE SYSTEM.

81. The range officer throws the switches so as to bring both arm setters' telephones in multiple with the reader's telephone in the station ordered. The B″ (or B′) arm is laid aside. The observer at B′ (or B″) follows the target, stopping the instrument with the horizontal wire on the water line and the vertical wire on the designated part of the target, at the last stroke of the bell. The reader transmits the azimuth and the range to the arm setters. The tracking is continued in this manner until **CEASE TRACKING** or **CHANGE TARGET** is ordered. Both arm setters hear azimuth and range. If B′ is sending information, No. 2, on hearing the azimuth, sets the primary arm; No. 3 notes the range and calls it to the plotter as soon as No. 2 calls "set." If B″ is sending information, No. 3 sets the secondary arm and No. 2 calls the range. The plotter places the targ against the arm at the range called by the arm setter, and the remaining operations are as prescribed for the horizontal base system.

82. Where instruments for both horizontal and vertical base systems are installed practice in the use of each will be held frequently. Special attention will be given to practice in changing from one system to the other.

83. The time interval bells will be cut off frequently and observations taken from a watch or clock in the B. C. station, **READY, TAKE**, being called over the line to the observers.

COINCIDENCE RANGE-FINDING SYSTEM.

84. The coincidence range finding system is similar to the vertical-base system. No. 2 sets the arm corresponding to the station, and No. 3 notes the range and calls it to the plotter, as soon as No. 2 calls "set." The telephone line from the coincidence range finding station to the plotting room should be provided with head sets for Nos. 2 and 3.

85. In batteries provided with a horizontal base, the coincidence range finding instrument is used as an emergency instrument.

EMERGENCY SYSTEM.

86. In addition to the regular system in use at the battery, every battery should be provided with one or more additional systems for use in emergency.

Batteries having the horizontal base system, should have at least one emergency station equipped with a coincidence range finder or a depression position finder. Those batteries provided only with self-contained bases (either vertical or horizontal) should have additional instruments located at various points for use in emergency.

MORTAR BATTERY.

MANNING DETAILS.

87.

- B. C. station:
  - Battery commander.
  - Assistant battery commander.
  - Battery commander's observer.
  - Operator for each telephone.
  - Azimuth keeper (who operates time azimuth board).
  - Musician.
- Plotting room:
  - Range officer.
  - Plotter.
  - No. 1, assistant plotter.
  - No. 2, arm setter.
  - No. 3, arm setter.
  - No. 4, azimuth computer.
  - No. 5, operator of device for transmitting data to the pits.
- Observing stations (for each):
  - Observer.
  - Reader.

INDICATION AND IDENTIFICATION OF A TARGET.

88. The methods of indication and identification are the same as those prescribed for a gun battery (par. 77), except that targets are not indicated to, or identified by, the gun pointers.

HORIZONTAL BASE SYSTEM.

89. The command **TRACK** having been given, the target is plotted by means of the primary and secondary arms from azimuths taken simultaneously from B′ and B″ in the same manner as prescribed for a gun battery. (Par. 80.)

PREDICTING AND FIRING.

90. In the following description, showing the different steps in their order, both firing and predicting intervals are assumed to be one minute. For convenience of explanation, the observations on which predictions are to be made are designated as "time 1," "time 2," etc., the intermediate (or half-minute) observations being designated "½," thus "time 1," "time 1½," "time 2," etc. After a target has been assigned, upon the command **TRACK,** the target is plotted every half minute.

Time 1 is the first plotted position of the target, time 1½ is the next, and time 2 is the third plotted position, necessary to make a prediction. The prediction may then be made at time 2, and the salvo or shot fired at time 3, 1 minute after time 2.

The zone should be indicated before time 2; to do this the plotter, after time 1½, the last intermediate observation before time 2, estimates the position at which the target will be plotted at time 2, and also the approximate location of the predicted and set forward points, brings up the mortar arm, calls out the zone and notes for his own use the time of flight; a well instructed plotter should be able to make this estimate without material error in the time.

As soon as the position of the target is plotted from the observations taken at time 2, the plotter calls or signals **CLEAR,** the primary and secondary arms are moved so as to clear the course of the target, the plotter applies the predicter holding it at an angle of about 45° with the board, the 10-second pointers to the side toward which the target is moving, and marks the predicted and set-forward points. Then he lays the predicter to one side, brings the graduated edge of the mortar arm to the set-forward point, and calls out the elevation. No. 4 immediately sets his deflection board for this elevation while No. 5 repeats the elevation over the telephone to the booth at the same time recording it on his record sheet and transmitting it by his electrical or mechanical device. While the plotter is getting the elevation, No. 1 reads the azimuth of the set-forward point and calls it out to No. 4 after the plotter has called the elevation. No. 4 then obtains the corrected azimuth and calls it to No. 5 who records and transmits it in a similar manner as for elevation. (No. 4 instead of No. 5 may wear the telephone head set on the line to the pits.)

The plotter next brings the graduated edge of the mortar arm to the predicted point and calls "set"; then No. 1 transmits the azimuth of the predicted point to the battery commander's observer, who sets the battery commander's instrument to this azimuth. The pit being ready, the signal for firing is given when the target crosses the vertical wire of the instrument, provided the time of crossing indicates that no considerable error has been made in prediction. This is a matter for the exercise of judgment by the battery commander or his assistant, but, in general, if the time of crossing varies more than five seconds from the predicted time the command **RELAY** should be given to the pits.

The required data having been transmitted, the plotter notes the travel during the last minute, estimates the position of the next predicted and set-forward points, brings up the mortar arm, reads the zone number, and estimates the time of flight for the next shot or salvo. The tracking is then resumed.

The predicting interval is not necessarily equal to the firing interval and is ordinarily taken as one minute.

With sufficiently well-trained personnel, the firing interval may be reduced to 45 or 30 seconds and 1 minute predictions made every 45 or 30 seconds.

If the battery commander's station is also the primary station, the primary arm, instead of the mortar arm, is brought to the predicted point, and No. 2 reads and transmits to the battery commander's observer the azimuth of the predicted point.

DUTIES OF THE AZIMUTH KEEPER.

91. The azimuth keeper operates the time azimuth board. He receives his data from the plotting room and immediately calls "error" if he discovers any large error which can not be accounted for by a change of zone or other normal change.

THE VERTICAL BASE SYSTEM, THE COINCIDENCE RANGE FINDING SYSTEM, AND THE EMERGENCY SYSTEM.

92. The vertical base system, the coincidence range finding system, and the emergency system are used under the same conditions and in the same manner as provided for a gun battery, so far as the location of the track on the plotting board is concerned. Predicting and firing are as prescribed for the horizontal base system for mortars.

Chapter VI.

FIRE DIRECTION FOR BATTERIES OF THE MINOR ARMAMENT.

MANNING PARTY.

93.

Battery commander's station:
- Battery commander.
- Observer.
- Range board operator.
- Deflection board operator.
- Operator for transmission device.
- Operator for telephone to fire (mine) commander's station.
- Operator for telephone to spotting station.
- Musicians.

Spotting station:
- Spotter.
- Assistant.

94. Each member of the manning party, on reaching his station, examines the apparatus to which assigned, makes the prescribed tests and adjustments, and reports to his chief of detail. On completion of the examination, the chief of detail reports to the battery commander: "Sir, B. C. (or spotting) station in order."

95. Having identified a target indicated to him by the fire (mine) commander, the battery commander indicates it to the observer, gun pointers, and spotters by commands similar to those prescribed in paragraph 77.

96. When satisfied that the target has been identified, the battery commander commands **TRACK**, whereupon the observer, the gun pointers, and the spotters follow the target. The observer announces the range frequently.

The operator of the range board determines and sets the corrected range on the (mechanical) transmission device.

97. The battery commander determines the travel by means of his instrument and makes the necessary deflection corrections for wind, drift, and travel.

(a) TO RANGE FROM ONE GUN.

98. The battery commander commands **NO. — FIRE ONE SHOT**; the piece is loaded and fired, under the direction of the gun commander, at the corrected range and deflection indicated on the transmission device. With the vertical wire of his sight set at the deflection used by the ranging gun, each gun pointer follows the target by traversing the gun until the instant of splash, when he stops traversing, quickly moves the vertical wire to the splash without moving the gun, then reads and reports his deflection to the battery commander.

From the reports of the gun pointers and the spotters, and from his own observation, the battery commander causes the necessary corrections to be applied in order to place the next shot on the target. Additional ranging shots are fired until the battery commander is satisfied with his corrections, and then he commands, **BATTERY COMMENCE FIRING.**

Range and deflection corrections are made throughout the firing as often as necessary.

During any series of firing, the battery commander is kept informed of the deviation of the shots by the spotters, who report at frequent intervals "Short (or over) ——— or Hit."

Firing from any gun may be stopped by ringing the gong in the emplacement therefor, or by the command **NO. — CEASE FIRING.**

Firing from the battery may be stopped by setting the mechanical transmission device to read 0 0 0 0, by ringing all bells, or by the command **CEASE FIRING** (given by mouth or by bugle).

(b) SHEAF RANGING.

99. Sheaf ranging consists in firing two or more guns at the same instant with their range settings differing by equal increments and increased or decreased from the right by the specified increment in yards, observing the relative positions of target and splashes, and making corrections from these observations.

100. The battery commander designates the ranging gun and the range difference between adjacent guns and commands **SHEAF RANGING**, at which command all guns are loaded. The ranging gun is laid on the range shown on the mechanical transmission device. Other guns are laid on this range corrected for their proper range differences. All guns are fired on a signal from the battery commander. All gun pointers determine and report their deflections as prescribed for ranging from one gun. Spotters report the distance of the nearest splash from the target in terms of multiples of the sheaf, "Second (or other) splash short ——— (or over), as third splash short 1/4." From spotters' and gun pointers' reports and from his own observation of splashes, the battery commander causes the necessary corrections to be applied, fires additional shots from the ranging gun, or opens with the battery at once, as conditions warrant.

101. Ranging by sheaf is a simple method, if the spotter's station is located well off to the flank of the battery or far above the level of the gun. The distance between splashes provides a measure for estimating the distance from any splash to the target. The method is valueless when the guns are on a low site and the battery commander's and spotter stations are near the battery, as one splash may obscure the others.

(c) EMERGENCY FIRING.

102. If the range finding system is out of action, or if there is no range finder, the battery commander ranges solely by observation. In such cases the battery commander's observer is provided with pad, pencil, and stop watch.

The procedure is the same as when operating with a range finder, except in the following particulars:

1. The battery commander proceeds as in the normal system, except that he estimates the first range and the range increment.

2. The observer records and every five seconds calls the range to the range board operator. The range called differs from the preceding one by the amount of the range increment.

(d) NOTES.

103. The spotting station will be located in such a position that the most accurate results of the observation of overs and shorts may be obtained.

104. A spotting station on the flank of the battery is especially desirable for night firing.

105. For night firing, if the target is well illuminated, the normal system will apply, but if the illumination is poor, the emergency system will be used.

106. Ammunition provided with the Semple tracer is of material aid to the battery commander in deciding when he is on the target. The use of a tracer at night provides the same facility for determining the deflection corrections as now obtains in day practice. The same reliance, however, can not be placed on the estimates of overs and shorts from the battery as by day.

107. Sheaf ranging is preferable for night and emergency firing, and for day firing if the spotting station is well on the flank.

108. Where permanent installation is not provided, one or more battery commander's stations will be improvised at suitable places on the flanks of the battery.

109. Deflection and range boards as described in paragraphs 386 and 395 will be improvised until standard boards are supplied. Where no mechanical transmission devices are installed, they will be improvised, if practicable. If not practicable, telephone or other means of communication will be used.

Chapter VII.

12-INCH MORTAR DRILL.

THE PIT SECTION.

110. Each pit of four mortars is manned by a pit section (88 enlisted men plus the reserve detachment) consisting of a pit commander, four mortar detachments, an ammunition detachment, and a reserve detachment.

111. Each mortar detachment (14 enlisted men) consists of a chief of detachment, an azimuth setter, an elevation setter, and 11 cannoneers numbered from 1 to 11, inclusive.

112. The ammunition detachment (31 enlisted men) consists of a chief of ammunition and 30 cannoneers numbered from 1 to 30, inclusive. This detachment is divided by the chief of ammunition into details for the service of powder and projectiles.

113. The reserve detachment consists of all unassigned cannoneers. It is posted by the pit commander at some convenient place, and is used by him to fill vacancies in the other detachments.

114. To post the pit section.—The section is posted as prescribed in detail in paragraph 40. The pit commander commands **DETAILS, POSTS**, and after the cannoneers are posted, he commands **EXAMINE GUN**.

115. To call off.—The battery commander may at any time give the command **CALL OFF**, which is repeated by the pit commander. The cannoneers in each detachment call off their numbers, beginning at 1.

116. To load and fire.—The battery commander indicates the target as prescribed in Chapter V. He designates the kind of projectile to be used and the mortars to be fired, and after the necessary data have been determined, commands **COMMENCE FIRING**.

The pit commander commands **LOAD** when the battery commander gives the command **COMMENCE FIRING** and before each shot or salvo of a series.

The battery commander may give the command **LOAD**, in which case the pit commander repeats the command. The pieces are loaded but are not fired until the battery commander commands **COMMENCE FIRING**. When the number of shots or salvos specified has been fired, the pit commander commands **CEASE FIRING**. When not specified, the battery commander commands **CEASE FIRING**, and the pit commander repeats the command.

117. When dummy ammunition is used, unless otherwise ordered, the mortars are unloaded at the command **CEASE FIRING**.

DUTIES OF THE EMPLACEMENT OFFICER.

(For mortar batteries the term "pit" officer is authorized.)

118. In addition to the duties prescribed for the emplacement officer in Chapter IV, he observes the progress of the loading, and if it is apparent that either one or two pieces will not be laid in time, he commands **NO.** —, or **NOS.** — —, **TAKE COVER.** If it is apparent that more than two pieces will not be laid in time, he commands **RELAY** and reports to the battery commander. When two or more pieces are laid and all details have taken cover, he closes the safety switch (if firing by electricity) and reports or signals A (or B) **PIT READY** to the battery commander.

Should circumstances arise after he has reported or signaled **PIT READY** to the battery commander that, in his opinion, would make it unsafe to fire, he breaks the firing circuit (or causes lanyards to be dropped when firing by lanyard) and reports to the battery commander.

119. When there is no emplacement officer, the pit commander performs the duties prescribed for the emplacement officer in addition to his own duties.

120. The following drill is prescribed for each mortar detachment:

12-inch mortar drill.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Chief of detachment (noncommissioned officer).	The chief of detachment takes post where he can supervise the mortar detachment.	The chief of detachment makes a careful inspection of the mortar and carriage and reports to the pit commander.
Azimuth setter (noncommissioned officer or private).	The azimuth setter takes post at the traversing cranks, facing the mortar.	The azimuth setter examines the azimuth index for adjustment by observing the mark made on the racer when the piece was last oriented, and examines and tests the traversing mechanism.
Elevation setter (noncommissioned officer or private).	The elevation setter takes post at the quadrant or elevation pointer, facing it.	The elevation setter examines the quadrant and tests the elevating mechanism, assisted by No. 5.

12-inch mortar drill.

At command **LOAD**.	At command **RELAY**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
The chief of detachment supervises the work of his detachment, assists in ramming the projectile, verifies the laying of the piece in azimuth and elevation, and calling "**NO...... READY**," takes cover after all of his detachment have taken cover. If his detachment is ordered to take cover before the piece is laid, he cuts it out of the firing circuit by opening the proper switch or by causing No. 2 to quit the lanyard when firing by lanyard. He observes the muzzle of his mortar when a salvo is fired, and in case of a misfire calls out **NO....... MISFIRE.**	The chief of detachment's duties are the same as at the command **LOAD**.	The chief of detachment supervises the work of his detachment.
The azimuth setter takes post at a run and traverses the piece rapidly to the nearest limit of the loading position, as indicated by a paint mark on the iron portion of the azimuth circle. He assists in ramming the projectile. He then traverses the piece as rapidly as possible to the azimuth setting posted.	The azimuth setter returns to the piece at a run and sets the piece for the new azimuth, and takes cover.	The azimuth setter traverses the piece to the nearest limit of the loading position, and assists in extracting the projectile.
The elevation setter takes post at a run, unclamps and depresses the piece to the loading position as rapidly as possible, but without shock, and sees that the spring latch is engaged. He sets the quadrant for the elevation as soon as it is posted, and assisted by No. 5 elevates rapidly to the approximate elevation. Then he sets the piece accurately, clamps it, and takes cover.	The elevation setter returns to the piece at a run and lays the piece for the new elevation, clamps it, and takes cover.	The elevation setter returns to the piece and proceeds as at the command **LOAD**.

12-inch mortar drill—Continued.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Breech detail, Nos. 1, 2, and 3; No. 1 is chief of breech.	No. 1 procures a wiper or cotton waste and a can containing lubricating oil and a sponge. He places the can convenient to the breech, and takes post 1 yard to the rear and right of the breech facing it. No. 2 procures a wiper or cotton waste and the long lanyard (if a lanyard is used) which he coils with the hook on top and places convenient to the breech. He takes post 1 yard to the rear and left of the breech, facing it. No. 3 procures primers, primer pouch, punch, drill, reamer and firing mechanism, and takes post to the right of the breech, facing No. 1.	Nos. 1 and 2 remove the breech cover and place it at the designated place. No. 1 examines the breech mechanism, breechblock, breech recess, chamber, and bore, and gives the necessary instructions for sponging if necessary. No. 2 examines the breech recess and gas check seat, cleans and oils them, examines the long lanyard (if one is used), and assists in sponging. No. 3 examines the vent and the firing mechanism. He clears the vent and cleans the primer seat.
Rammer detail, No. 4.	No. 4 procures the rammer and extractor, places the latter on the rack or prop, and takes post as prescribed for cover post, rammer vertical, head on the floor of the emplacement.	No. 4 places the rammer on the prop, and assists in sponging when necessary.

12-inch mortar drill—Continued.

At command **LOAD.**	At command **RELAY.**	At command **CEASE FIRING.** (When dummy ammunition is used.)
Nos. 1, 2, and 3 take posts at a run. Nos. 1 and 2 open breech. No. 1 cleans and oils the breechblock, when necessary, and assists in ramming. He pushes the powder charge into the chamber by hand until its base barely clears the gas-check seat, and takes cover as soon as the breech is closed. No. 2 wipes any residue from the gas check seat and breech recess and assists in ramming. He releases the tray latch, and closes breech. When the mortar is to be fired by lanyard, he attaches the long lanyard to the short one, straightens the lanyard after the detail has taken cover, and pulls it at the command **FIRE.** After the breechblock is completely closed, No. 3 inserts a primer in the vent, lowers the leaf of the firing device *completely down*, and commands **ELEVATE.** When the mortar is to be fired by lanyard he hooks the short lanyard *after the piece is elevated above 45°*, and takes cover. As soon as the breech is open, after the piece is fired, he removes the old primer, clears the vent and cleans the primer seat.	No. 1 remains at *cover post.* No. 2 slacks his lanyard (if one is used). No. 3 remains at *cover post.* If the command **DRAW POWDER CHARGE** has been given also, Nos. 1 and 2 return to the piece at a run. No. 2 unhooks the short lanyard (if a lanyard is used) *before the mortar is depressed*, and as soon as the mortar is clamped in the loading position, No. 1 opens breech. No. 2 withdraws the powder charge and passes it to No. 6 as soon as the latter has thrust in a new charge. No. 1 pushes the new one in place and No. 2 closes breech. No. 3 hooks the short lanyard *after the piece is elevated above 45°.* No. 2 straightens out the long lanyard and stands ready to fire.	Nos. 1 and 2 proceed as at the command **RELAY DRAW POWDER CHARGE,** until the powder charge is withdrawn. Then they assist in withdrawing the projectile. No. 3 returns to the piece, removes the primer as soon as the breech is opened, and assists in withdrawing the projectile.
No. 4 raises the rammer to a horizontal position, places the head against the projectile and runs forward with the truck, and assisted by the chief of detachment, the azimuth setter, Nos. 1 and 2, rams the projectile home with all possible force as soon as the truck comes to rest with its buffer against the face of the breech. They withdraw the rammer quickly, and all quit the rammer except No. 4, who carries the rammer above his head, and takes post bringing the rammer to a vertical position.	No duties.	No. 4 carries the rammer to the prop and brings the extractor to the breech, assists in withdrawing the projectile, returns the extractor to the prop, and takes the rammer to his post.

12-inch mortar drill—Continued.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Elevating detail, No. 5.	No. 5 takes post at the elevating wheel, facing it.	No. 5 removes the muzzle cover and places it at the designated place, assists the elevation setter in testing elevating mechanism, cleans and oils the gear.
Powder-serving detail, No. 6.	No. 6 procures a wrench for filling plugs, a measure containing hydrolene oil, and a funnel, and places them convenient to the piece. He then takes post near the entrance to the powder magazine.	No. 6 unscrews the filling plugs of both recoil cylinders and if oil is needed, fills them. Then he notifies the chief of detachment that the cylinders are ready for inspection. After the inspection he screws the filling plugs well home and replaces his implements.
Truck details, Nos. 7, 8, 9, and 10.	Nos. 7 and 8 bring out a loaded truck and run it to a point about 10 feet in rear of the breech, No. 7 on the right and No. 8 on the left. Nos. 9 and 10 run an empty truck alongside the delivery table in the shot gallery, No. 9 on the right and No. 10 on the left.	Nos. 7 and 8, 9 and 10, examine the trucks and clean and oil them.

12-inch mortar drill—Continued.

At command **LOAD**.	At command **RELAY**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
No. 5 runs to the elevating handwheel, and at the command **ELEVATE**, elevates rapidly to the approximate elevation and takes cover.	No. 5 returns to the piece at a run, elevates under direction of the elevation setter, and takes cover. If the command **DRAW POWDER CHARGE** has been given also, he proceeds as at the command **COMMENCE FIRING**, and takes cover as soon as the piece is again clamped in elevation.	No. 5 returns to the piece and proceeds as at the command **COMMENCE FIRING** until the piece is clamped in the loading position.
No. 6 receives the powder charge on a powder serving tray from a member of the ammunition detachment before leaving his cover post, and follows the truck to the breech. As soon as the truck has been removed, he inserts the tray into the breech recess, and as soon as the powder charge has been pushed into the chamber by No. 1, he withdraws the tray and takes his post at a run, carrying the tray with him.	No. 6 remains at *cover post* except when the command **DRAW POWDER CHARGE** has been given also, in which case he brings up the next charge and thrusts it in the chamber as soon as No. 2 has withdrawn the old one. He then receives the old charge from No. 2 and takes cover, turning over the old powder charge to a member of the ammunition detachment.	No. 6 receives the powder charge from No. 2, and returns it to the ammunition detachment.
Nos. 7 and 8 (or 9 and 10) run a truck from the position of cover to the loading position (about ten feet in rear of the breech) and 9 and 10 (or 7 and 8) run a loaded truck from the gallery to the position of cover just vacated by 7 and 8 (or 9 and 10). At the proper time 7 and 8 (or 9 and 10) push the truck forward rapidly and bring it up against the face of the breech without shock, timing their arrival at the breech so as to clear the block as it is swung to *open*. As soon as the projectile has been rammed, they withdraw the truck promptly and run it backward into the shot gallery and alongside of the delivery table, roll a new projectile on the truck, and at the next shot run the reloaded truck rapidly to the position of cover just vacated by 9 and 10 (or 7 and 8), who have pushed their truck forward to the loading position.	No duties.	Nos. 7 and 8 (or 9 and 10) bring out empty truck from the gallery and when projectile is drawn back onto the truck return it to the gallery.

12-inch mortar drill—Continued.

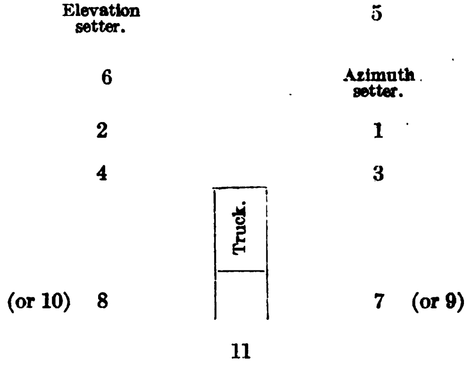
Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Sponge detail, No. 11.	No. 11 procures the chamber and bore sponge and a vessel containing hydrolene oil, places the vessel well in rear of the pit, and holding the sponge with the head toward the pit, takes post near the vessel facing the pit. (When no firing is to take place the vessel may be empty.) The four numbers 11 align themselves to the right.	No. 11 brings up the chamber and bore sponge when called for by No. 1.

12-inch mortar drill—Continued.

At command **LOAD**.	At command **RELAY**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
No. 11 dips the head of the sponge in the hydrolene oil, and allows the excess oil to run off; after each shot, he rushes forward with the sponge, and as soon as the breechblock is opened, sponges the chamber, assisted by the breech detail.	No duties.	No duties.

NOTES ON THE DRILL.

121. At the command **TAKE COVER**, the mortar detachments take positions in rear of the pit, arranged in order from the right (No. 1 detachment on the right). Each detachment is in double column, as follows:



122. The cover post for No. 4 is the same as his regular post, and the detachment forms on him at the command **TAKE COVER**. He does not quit the rammer except at the command **CEASE FIRING**, or when directed to do so, in which cases he places the rammer on the rack or prop.

123. When powder is not served from the rear of the pit, the cover post of No. 6 is near the entrance of the gallery from which powder is served.

124. In taking cover, the details proceed to their posts as rapidly as possible, but should avoid interfering with those whose duties at the piece have not been completed.

125. The service of the mortar is conducted habitually as though a salvo had just been fired (pieces elevated and detachments at cover post), but in case the command **COMMENCE FIRING** or **LOAD** is given when the details are at their posts and the pieces in the loading position, No. 6 proceeds at a run to the point designated for receipt of the powder charge.

126. When mortars are equipped for firing by electricity, they are fired by the emplacement officer at the signal of the battery commander. Mortars are fired by lanyard if the electrical firing circuit is not installed or is out of order. When the lanyard is used, the emplacement officer commands **FIRE** at the firing signal of the battery commander.

127. The chief of ammunition is in command of the ammunition detachment, and has charge, under the pit commander, of the galleries and magazines pertaining to his emplacement.

He is responsible for the condition of the projectiles, trolleys, delivery tables, and for the police of the galleries and magazines.

When the details are posted, he makes an inspection of the trolleys, magazines, and galleries and reports to the pit commander "Ammunition service in order," or reports defects he is unable to remedy without delay.

He is responsible that all trucks are loaded and delivery tables filled with projectiles at the beginning of an action. During drill or action he supervises the service of ammunition.

Chapter VIII.

12 OR 14 INCH GUN DRILL (DISAPPEARING CARRIAGE).

THE GUN SECTION.

128. Each emplacement is manned by a gun section (42 enlisted men plus the reserve detachment), consisting of a gun detachment, an ammunition detachment, and a reserve detachment. The gun commander is in command of the gun section, and is also chief of the gun detachment.

129. The gun detachment (29 enlisted men) consists of the gun commander, the gun pointer, the chief of breech, the range setter, the range recorder, the deflection recorder, and 23 cannoneers, numbered from 1 to 23, inclusive. The gun detachment is divided into details as shown in the drill which follows.

130. The ammunition detachment (13 enlisted men) consists of the chief of ammunition and 12 cannoneers, numbered from 24 to 35, inclusive. The ammunition detachment is divided into details for the service of powder and projectiles according to the location of magazines, shot rooms, and hoists pertaining to the emplacement.

131. The reserve detachment consists of all unassigned cannoneers. It is divided into two reserve details, one for the gun detachment and one for the ammunition detachment. The reserve detachment is posted by the gun commander at some convenient place or places, and is used by him to fill vacancies in the other detachments.

132. To post the gun section.—The section is posted as prescribed in detail in par. 40. The gun commander commands **DETAILS, POSTS**, and after the cannoneers are posted he commands **EXAMINE GUN**.

133. To call off.—The battery commander may at any time give the command **CALL OFF**, which is repeated by the gun commander. The cannoneers call off their numbers, beginning at one.

134. To load and fire.—The battery commander indicates the target as prescribed in Chapter V. He designates the kind of projectile to be used, and after tracking has begun commands.

(*a*) **COMMENCE FIRING.**

(*b*) **FIRE ——— ROUNDS, COMMENCE FIRING.**

(*c*) **NUMBER(S) ——— FIRE ——— SHOTS, COMMENCE FIRING.**

The gun commander commands **LOAD** when the battery commander gives the command **COMMENCE FIRING**, and before each shot of a series.

The battery commander may give the command **LOAD**, in which case the gun commander repeats the command. The piece is loaded but is held from battery until the battery commander commands **COMMENCE FIRING**.

When the number of rounds specified has been fired, the gun commander commands **CEASE FIRING**, at which command all cannoneers resume their posts.

When the number of rounds is not specified, the battery commander commands **CEASE FIRING**, and the gun commander repeats the command.

185. When dummy ammunition is used, the piece is unloaded at the command **CEASE FIRING**, unless otherwise ordered.

186. The following drill is prescribed:

12 or 14 inch gun drill (disappearing carriage).

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Gun commander (noncommissioned officer).	The gun commander gives the command **DETAILS, POSTS** and supervises the procuring of equipment and implements. He posts the reserve detachment.	The gun commander gives the command **EXAMINE GUN**, makes a general inspection of the gun and carriage, and reports to the emplacement officer.
Gun pointer (noncommissioned officer or private).	The gun pointer procures the sight, places it in its seat, and takes post on the sighting platform.	The gun pointer examines the sight and verifies the adjustment of the azimuth index. He examines the traversing mechanism and the electric firing mechanism and circuit (if used).
Range setter (noncommissioned officer or private).	The range setter takes post facing the range scale.	The range setter examines the elevating and retracting mechanisms, and cleans and oils the gears if necessary.
Range recorder (noncommissioned officer or private).	The range recorder procures chalk, a ruler, a blackboard eraser, and a stop watch, and takes post at the time-range board.	The range recorder examines the time-range board. He puts on the head set and tests the telephone to the plotting room.
Deflection recorder (noncommissioned officer or private).	The deflection recorder procures chalk, and a blackboard eraser, and takes post at the deflection recorder's board.	The deflection recorder examines the deflection recorder's board. He puts on the head set and tests the telephone to the plotting room.

12 or 14 inch gun drill (disappearing carriage).

At command **LOAD**.	At command **CEASE FIRING** (when dummy ammunition is used).
The gun commander gives the command **LOAD** and supervises the work of his section. After the chief of breech has given the command **TRIP**, the gun commander sees that the gun goes fully into battery, verifies the range setting, and if the setting is correct, calls **READY**.	The gun commander gives the command **CEASE FIRING** and supervises the work of unloading.
The gun pointer sets the deflection recorded on the deflection recorder's board and directs the traversing so that he will be on the target by the time the gun is in battery. He fires the piece or gives the command **FIRE** as soon after the command **READY** as the piece is pointed.	No duties.
At the command **TRIP** the range setter lays the piece for range in accordance with information obtained from the time-range board, as described in Par. 400.	No duties.
The range recorder continues plotting the time-range curve as prescribed in Par. 400.	The range recorder continues plotting the time-range curve.
The deflection recorder makes a record of the last deflection received when it differs from the last one recorded, erasing the latter.	The deflection recorder continues recording deflections.

12 or 14 inch gun drill (disappearing carriage)—Continued.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Breech detail, chief of breech (noncommissioned officer or private), and Nos. 1, 2, 3, and 21.	The chief of breech takes post 2 yards in rear of the breech, facing it. No. 1 procures a wiper or cotton waste and a can containing lubricating oil and a sponge. He places the can convenient to the breech and takes post about 1 yard to the rear and right of the breech, facing it. No. 2 procures the operating crank for the breech mechanism and places it in position. He also procures a wiper or cotton waste and takes post about 1 yard to the rear and left of the breech, facing it. No. 3 procures the lanyard (if one is used), primers, primer pouch, punch, drill, reamer, and firing mechanism, and takes post on the right side of the piece about 1 foot to the right and front of the elevating band, facing to the rear. No. 21 takes post about 2 feet to the right of the breech on line with its face, facing it. (NOTE.—For 14-inch guns the distances of Nos. 1, 2, 3, and 21 from the breech may be increased.)	The chief of breech examines the breech mechanism, breechblock, breech recess, chamber, and bore, and gives the necessary orders for cleaning and putting them into condition for service. Nos. 1 and 21 remove the breech cover and place it at the designated place. They clean and oil the breechblock and breech mechanism. No. 2 cleans and oils the breech recess and gas check seat. No. 3 examines the vent and the firing mechanism. He clears the vent and cleans the primer seat. He coils the long lanyard (if one is used) and hangs it over the end of the elevating arm.
Rammer detail, Nos. 4, 22, and 23.	Nos. 4 and 22 procure the rammer and place it on the hooks near the rail, head toward the hoist. No. 4 takes post about 2 yards from the head of the rammer, within reach of the staff, facing the piece. No. 22 takes post 4 yards to the left of No. 4, facing the piece. No. 23 procures the extractor for the dummy projectile and places it near the rammer, takes post 4 yards to the right of No. 4, facing the piece.	No. 4 assists the breech detail in cleaning when necessary. No. 22 removes the muzzle cover, hands it to No. 8, who places it at the designated place. No. 23 assists No. 9 in filling the recoil cylinders, passing up the oil measure and the funnel when needed.
Elevating detail, Nos. 5 and 6.	Nos. 5 and 6 take posts at the elevating handwheel on the same side as the range setter, facing the piece.	Nos. 5 and 6 assist the range setter in examining the elevating and retracting mechanism, and in cleaning and oiling the gears.

12 or 14 inch gun drill (*disappearing carriage*)—Continued.

At command **LOAD**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
The chief of breech gives the command **HOME RAM** for ramming the projectile, and the command **IN BATTERY**, **TRIP** for tripping the gun. If a lanyard is used, he hooks the lanyard before the primer is inserted, and does not command **TRIP** until after the primer is inserted. After firing, he unhooks the lanyard. No. 1 places the head of the ramer against the base of the projectile as the truck approaches the breech, assists in ramming the projectile, closes breech, assisted by No. 2, and goes to his place on the rammer and stands by for the next shot. After each shot, No. 2 wipes the mushroom head and gas-check seat with a cloth moistened with hydrolene oil, then takes his place on the rammer, assists in ramming the projectile and assists No. 1 in closing breech. No. 3 inserts a primer after the breechblock is completely closed and lowers the leaf of the firing device *completely down*, steps back to the rear as the gun goes in battery, letting his lanyard (if one is used) uncoil, and pulls the lanyard (if one is used) at the command **FIRE**. After the piece is fired he coils the long lanyard (if a lanyard is used) and as soon as the breech is opened removes the old primer, clears the vent, and cleans the primer seat. No. 21 opens the breechblock, and cleans and oils it when necessary. He assists No. 1 with the crank when there is difficulty in closing the breech. If the projectile fails to seat at the first trial, he assists on the rammer. NOTE.—(The battery commander may require Nos. 1 and 2 to assist in ramming the powder, and the chief of breech to assist in ramming the projectile.)	The chief of breech supervises unloading. Nos. 1 and 2 assist in withdrawing the dummy powder charge and the dummy projectile. No. 3 removes the primer. No. 21 opens breech and assists in withdrawing the dummy projectile.
The truck is brought up to the face of the breech, and the projectile pushed carefully off the truck until the base of the projectile is just inside the powder chamber. The truck is then withdrawn and run off to one side. Nos. 1, 2, 4, 9, 10, 21, 22, and 23 then man the rammer as near the outer end as possible, and at the command **HOME RAM** by the chief of breech, they rush the projectile forward hard into its seat, increasing the speed of the rush so that the projectile will have its fastest movement when it comes up hard in its seat. The rammer detail pushes the powder off the powder tray and into the powder chamber to such a distance that the breechblock will give the powder charge a final push into the chamber in closing. NOTE.—(The battery commander may require Nos. 1, 2, 9, and 10 to assist in ramming the powder, and the chief of breech to assist in ramming the projectile.)	No. 4 brings up the extractor and pulls the dummy powder sections back onto the tray. He hooks the extractor into the dummy projectile and assists in withdrawing it. Nos. 22 and 23 assist in withdrawing the dummy projectile.
Nos. 5 and 6 elevate or depress the piece under direction of the range setter.	No duties.

12 or 14 inch gun drill (disappearing carriage)—Continued.

Details.	At command DETAILS, POSTS.	At command EXAMINE GUN.
Traversing detail, Nos. 7 and 8.	Nos. 7 and 8 procure the traversing cranks, place one of them on the shaft, on the same side as the gun pointer, and take posts at the crank facing to the rear.	Nos. 7 and 8 remove the drip pans, assist in testing the traversing mechanism. No. 8 receives the muzzle cover from No. 23 and places it at a designated place.
Tripping detail, Nos. 9 and 10.	No. 9 procures a wrench for filling plugs, a measure containing hydrolene oil, and a funnel, and goes to the right tripping lever. No. 10 procures a wrench for filling plugs and goes to the left tripping lever.	Nos. 9 and 10 mount on the chassis, each carrying a wrench, and remove the filling plugs from the recoil cylinders. If oil is needed, No. 9 calls on No. 23 for the funnel and measure, and pours oil into the right cylinder slowly. No. 10 watches the oil hole in the left cylinder. When both cylinders are full, No. 9 hands the funnel and measure back to No. 23 and notifies the gun commander that the cylinders are ready for inspection. After the inspection, Nos. 9 and 10 screw the plugs well home, and take posts facing the piece by the platform railing, No. 9 three yards to the right of No. 4, and No. 10 three yards to the left of No. 4.
Truck detail, Nos. 11 and 12.	Nos. 11 and 12 bring out the shot trucks to be used and take posts at the handles of one of the trucks—No. 11 on the right and No. 12 on the left.	Nos. 11 and 12 examine the trucks and clean and oil them when necessary. They then turn them over to the hoist detail for loading. When the first truck is loaded, they push it out to some convenient position in rear of the breech.
Powder serving detail, Nos. 13, 14, 15, and 16.	Nos. 13, 14, 15, and 16 bring out the powder trays to be used and turn them over to the ammunition detachment. They take posts opposite the first tray loaded, Nos. 13 and 15 on the right and Nos. 14 and 16 on the left, Nos. 13 and 14 in rear.	Nos. 13, 14, 15, and 16 see that the powder sections are arranged on the trays in the order in which they are to be inserted.
Hoist detail, Nos. 17, 18, and 19. No. 17 is chief of detail unless a noncommissioned officer is assigned in charge.	Nos. 17, 18, and 19 take posts at the delivery table.	Nos. 17, 18, and 19 examine and clean the delivery table and the projectiles on it. They examine the automatic stop. They load the trucks turned over to them by the truck detail.

12 or 14 inch gun drill (disappearing carriage)—Continued.

At command **LOAD.**	At command **CEASE FIRING.** (When dummy ammunition is used.)
Nos. 7 and 8 traverse the piece under direction of the gun pointer. They halt when the piece is fired and resume traversing as soon as the truck is withdrawn from the breech.	No duties.
Nos. 9 and 10 assist in ramming the projectile. As soon as the projectile is seated they quit the rammer and run to the tripping levers. At the command **IN BATTERY** they seize the tripping levers and at the command **TRIP** raise them quickly to the stops, hold them for an instant, then let go, and when the gun is in battery run back to their posts at the rammer, where they stand by for the next shot. If firing by electricity, No. 9 (or No. 10) closes the safety switch as soon as the gun is in battery. NOTE.—(The battery commander may require Nos. 9 and 10 to assist in ramming the powder.)	No duties unless the dummy projectile sticks, in which case they assist in starting it from its seat.
Nos. 11 and 12 run out a loaded shot truck, No. 12 adjusting the truck to the proper height in accordance with the position of the piece upon recoil. The truck is run forward so that the tray enters the breech recess squarely. As the truck brings up against the face of the breech No. 12 sets the brake. As soon as the projectile is pushed off the truck Nos. 11 and 12 run the truck back to the hoist and turn it over to the hoist detail. They then take posts behind a loaded truck and stand by for the next shot.	Nos. 11 and 12 push a truck into position at the breech to receive the dummy projectile and then return the truck to the loading position.
As soon as the rammer has been withdrawn after seating the projectile the nose of the powder tray is inserted in the breech by Nos. 13, 14, 15, and 16, and the rammer detail, in one motion, pushes carefully the entire powder charge off the tray to such a distance that the breech block will give the powder charge a final push into the chamber in closing. The tray is then removed and the breech closed.	Nos. 13, 14, 15, and 16 bring up an empty powder tray to receive the dummy powder sections and return the loaded tray to the loading position.
Nos. 17, 18, and 19 receive the empty truck after each shot, load it, and run it out conveniently for Nos. 11 and 12.	No duties.

12 or 14 inch gun drill (disappearing carriage)—Continued.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Sponge detail, No. 20.	No. 20 procures the chamber sponge and a vessel containing hydrolene oil, places them on the opposite side of the emplacement from the rammer, and takes post near the chamber sponge, facing the gun. (If there is to be no firing, the vessel may be empty.)	No. 20 brings up the chamber sponge when called for and assists in sponging the chamber.

12 or 14 inch gun drill (*disappearing carriage*)—Continued.

At command **LOAD**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
No. 20 dips the chamber sponge in the hydrolene oil and allows the excess oil to run off as soon as the breech block is opened after each shot, assisted by the breech detail, he sponges the chamber as quickly as practicable.	No duties.

NOTES ON THE DRILL.

(See also Chapters V, XV, XVI, and XXI.)

137. The service of the piece as given above is for a gun with an 1895 breech mechanism. If the gun has an 1888 breech mechanism, the duties of the breech detail differ in the following respects: No. 1 assists in opening the breechblock, oils the threads, and assists in closing the breech; No. 21 assists on the translating crank, if necessary.

138. **To open breech, model 1888 mechanism.**—No. 2 releases the rotating crank by turning the wing nut of the catch to the left and then turns the rotating crank clockwise, as indicated by the "open" arrow, until it brings up short in a horizontal position and is secured by its catch; No. 1 turns the translating crank briskly contraclockwise. When the shoulders of the grooves strike against the ends of the rails, the block stops short and the shock frees the tray latch from its catch; No. 1 swings the tray and block to the right until the securing latch engages in the catch.

139. **To close breech, model 1888 mechanism.**—No. 2 releases the securing latch from its catch; No. 1 swings the tray and block around to the left smartly; No. 2 seizes the handle of the tray and continues the swinging of the block until the tray abuts against and is latched to the face of the breech; then he turns the translating crank clockwise until the breech is translated completely; No. 1 releases the rotating crank by turning the wing nut and turns the rotating crank contraclockwise, as indicated by the "close" arrow, until it brings up short in a vertical position and is secured by its catch.

140. **To open breech, model 1895 mechanism.**—The chief of breech unhooks the lanyard (when one is used) from the eye of the firing leaf; No. 21 turns the crank continuously in a clockwise direction until the tray comes to a rest against the hinge plate and the securing latch catches.

141. **To close breech, model 1895 mechanism.**—No. 1 releases the securing latch and turns the crank in a contraclockwise direction until the projecting shoulder on the rotating lug striking the gear prevents further motion. The latch is released before the truck is withdrawn from the breech, holding the breechblock open by the operating crank until time to close it.

142. With the 1895 breech mechanism it will be convenient to fasten a wire around the piece back of the elevating band with a loop in which the safety lanyard (if a lanyard is used) may be hooked during the loading. The chief of breech after unhooking the lanyard swings it over the teeth of the breech mechanism and hooks it in the loop of the wire. Thus it is kept from being caught in the mechanism and is convenient to the chief of breech when the time comes to hook it again.

143. Prior to practice or action shot trucks are adjusted to the highest point to which it is anticipated the gun will recoil, since the adjustment is made downward more easily and rapidly than upward.

144. If the gun fails to go in battery completely, the gun commander orders Nos. 9, 10, 22, and 23 to use the pinch bars; these are engaged in the notches on the chassis and the gun is forced into battery. However, battery commanders will observe such defects at daily drill and will have the same remedied before practice or action.

145. **To retract the gun.**—Assuming that the gun is in battery, that the clutch is out, and that the cables are wound on the retraction drums, to retract the gun by hand the gun commander will command (1) **FROM BATTERY**, (2) **HEAVE**, (3) **HALT**. At the first command No. 7 releases the retaining pawl and turns the speed crank to permit the pulling out of the cables. Nos. 1 and 2 pull out the cables to their full length and pass the ends to Nos. 21 and 4, who will have mounted on the chassis. Nos. 21 and 4 pass the cables to Nos. 9 and 10, who will have mounted the gun levers, and who will place the ends of the cables on the hooks. No. 7 will then throw on the retaining pawl and will turn the speed crank to take up all slack, and No. 8 will push in the clutch, Nos. 21 and 4 watching the cables to see that they take the grooves of the drums. As soon as the slack has been taken up Nos. 4, 21, 9, and 10 return to the loading platform and Nos. 7 and 8 put on the retraction cranks.

The gun section is divided into two reliefs by the gun commander. The first relief takes post at the retraction cranks, and at the second command start to retract the gun. The reliefs alternate as directed by the gun commander. As soon as the crosshead teeth engage their pawls the retraction shaft retaining pawl is thrown off, and remains off until the cables have been unhooked from the gun levers.

When the gun has reached the loading position the gun commander commands **HALT**. At this command Nos. 7 and 8 remove the retraction cranks. No. 7, using the speed crank, lets out enough slack to enable Nos. 1 and 2 to unhook the cables. After the unhooking No. 7 takes up all slack with the speed crank and then throws the retaining pawl on. No. 8 then pulls out the clutch.

146. For retraction by power the above drill is modified as follows: Assuming the idler to be out of gear, after the cables have been hooked to the gun levers and the slack has been taken up by No. 7 and the clutch thrown in by No. 8, at the command **HEAVE** by the gun commander, No. 8 throws the idler in gear. As soon as this is done the range setter closes the main switch of the controller cabinet and moves the arm so as to turn on the power. The movements at the command **HALT** are the same as those prescribed for hand retraction, except that the range setter pulls the main switch of the controller cabinet, after which No. 8 throws the idler out of gear. The cables are then unhooked, and the slack taken up as prescribed for hand retraction.

147. On carriages equipped with friction brakes on the retraction crank shaft it is not necessary to unhook the cables from the gun levers. The time consumed in pulling out and hooking the cables is thereby saved. On carriages so equipped the cables need not be unhooked, and the drill may be modified accordingly.

Chapter IX.

8 OR 10 INCH GUN DRILL (DISAPPEARING CARRIAGE).

THE GUN SECTION.

148. Each emplacement is manned by a gun section (37 enlisted men plus the reserve detachment) consisting of a gun detachment, an ammunition detachment, and a reserve detachment. The gun commander is in command of the gun section, and is also chief of the gun detachment.

149. The gun detachment (26 enlisted men) consists of the gun commander, the gun pointer, the chief of breech, the range setter, the range recorder, the deflection recorder and 20 cannoneers, numbered from 1 to 20, inclusive. The gun detachment is divided into details as shown in the drill which follows.

150. The ammunition detachment (11 enlisted men) consists of the chief of ammunition and 10 cannoneers, numbered from 21 to 30 inclusive. The ammunition detachment is divided into details for the service of powder and projectiles according to the location of magazines, shot rooms, and hoists pertaining to the emplacement.

151. The reserve detachment consists of all unassigned cannoneers. It is divided into two reserve details, one for the gun detachment and one for the ammunition detachment. The reserve detachment is posted by the gun commander at some convenient place or places, and is used by him to fill vacancies in the other detachments.

152. To post the gun section.—The section is posted as prescribed in detail in paragraph 40. The gun commander commands **DETAILS, POSTS**, and after the cannoneers are posted, he commands **EXAMINE GUN**.

153. To call off.—The battery commander may at any time give the command **CALL OFF**, which is repeated by the gun commander. The cannoneers call off their numbers beginning at one.

154. To load and fire.—The battery commander indicates the target as prescribed in Chapter V. He designates the kind of projectile to be used, and after tracking has begun, commands:

(*a*) **COMMENCE FIRING.**

(*b*) **FIRE ——— ROUNDS, COMMENCE FIRING.**

(*c*) **NUMBER(S) ——— FIRE ——— SHOTS, COMMENCE FIRING.**

The gun commander commands **LOAD** when the battery commander gives the command **COMMENCE FIRING**, and before each shot of a series.

The battery commander may give the command **LOAD**, in which case the gun commander repeats the command. The piece is loaded but is held from battery until the battery commander commands **COMMENCE FIRING**.

When the number of rounds specified has been fired, the gun commander commands **CEASE FIRING**, at which command all cannoneers resume their posts.

When the number of rounds is not specified, the battery commander commands **CEASE FIRING**, and the gun commander repeats the command.

155. When dummy ammunition is used, the piece is unloaded at the command, **CEASE FIRING**, unless otherwise ordered.

156. The following drill is prescribed:

8 or 10 inch gun drill (disappearing carriage).

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Gun commander (noncommissioned officer).	The gun commander gives the command **DETAILS, POSTS** and supervises the procuring of equipments and implements. He posts the reserve detachment.	The gun commander gives the command **EXAMINE GUN,** makes a general inspection of the gun and carriage and reports to the emplacement officer.
Gun pointer (noncommissioned officer or private).	The gun pointer procures the sight and places it in its seat and takes post on the sighting platform.	The gun pointer examines the sight and verifies the adjustment of the azimuth index. He examines the traversing mechanism and the electric firing mechanism and circuit (if used).
Range setter (noncommissioned officer or private).	The range setter takes post facing the range scale.	The range setter examines the elevating and retracting mechanisms. He cleans and oils the gears.
Range recorder (noncommissioned officer or private).	The range recorder procures chalk, a ruler, a blackboard eraser, and a stop watch and takes post at the time range board.	The range recorder examines the time-range board. He puts on the head set and tests the telephone to the plotting room.
Deflection recorder (noncommissioned officer or private).	The deflection recorder procures chalk and a blackboard eraser, and takes post at the deflection recorder's board.	The deflection recorder examines the deflection recorder's board. He puts on the head set, and tests the telephone to the plotting room.
Breech detail, chief of breech (noncommissioned officer or private), and Nos. 1, 2, and 3.	The chief of breech takes post 2 yards in rear of the breech, facing it. No. 1 procures a wiper or cotton waste and a can containing lubricating oil and a sponge. He places the can convenient to the breech and takes post about 1 yard to the rear and right of the breech, facing it. No. 2 procures the operating crank for the breech mechanism and places it in position. He also procures a wiper or cotton waste and takes post about 1 yard to the rear and left of the breech, facing it. No. 3 procures the lanyard (when one is used), primers, primer pouch, punch, drill, reamer, and firing mechanism, and takes post on the right side of the piece, about 1 foot to the right and front of the elevating band, facing to the rear.	The chief of breech examines the breech mechanism, breechblock, breech recess, chamber, and bore, and gives the necessary orders for cleaning and putting them into condition for service. No. 1 removes the breech cover and places it at the designated place. He cleans and oils the breechblock and breech mechanism. No. 2 cleans and oils the breech recess and gas check seat. No. 3 examines the vent and the firing mechanism. He clears the vent and cleans the primer seat. He coils the long lanyard (if one is used) and hangs it over the end of the elevating arm.

8 or 10 inch gun drill (disappearing carriage).

At command **LOAD**.	At command **CEASE FIRING** (when dummy ammunition is used).
The gun commander gives the command **LOAD** and supervises the work of his section. After the chief of breech has given the command **TRIP**, the gun commander sees that the gun goes fully into battery, verifies the range setting, and if the setting is correct, calls **READY**.	The gun commander gives the command **CEASE FIRING**, and supervises the work of unloading.
The gun pointer sets the deflection recorded on the deflection recorder's board and directs the traversing so that he will be on the target by the time the gun is in battery. He fires the piece or gives the command **FIRE** as soon after the command **READY** as the piece is pointed.	No duties.
At the command **TRIP** the range setter lays the piece for range in accordance with information obtained from the time-range board as prescribed in Paragraph 400.	No duties.
The range recorder continues plotting the time-range curve, as prescribed in Par. 400.	The range recorder continues plotting the time-range curve.
The deflection recorder makes a record of the last deflection received when it differs from the last one recorded, erasing the latter.	The deflection recorder continues recording deflections.
The chief of breech gives the command **HOME RAM** for ramming the projectile, and the command **IN BATTERY TRIP** for tripping the gun. If a lanyard is used, he hooks the lanyard before the primer is inserted, and does not command **TRIP** until after the primer is inserted. After firing he unhooks the lanyard. Nos. 1 and 2 open the breech. No. 1 places the head of the rammer against the base of the projectile as the truck approaches the breech, assists in ramming the projectile, and closes breech, assisted by No. 2. After each shot No. 2 wipes the mushroom head and gas-check seat with a cloth moistened with hydrolene oil, then takes his place on the rammer, assists in ramming the projectile, and assists No. 1 in closing the breech. No. 3 inserts a primer after the breechblock is completely closed and lowers the leaf of the firing device *completely down*, steps back to the right and rear as the gun goes in battery, letting his lanyard (if one is used) uncoil. He pulls the lanyard (if one is used) at the command **FIRE**. After the piece is fired he coils the long lanyard (if a lanyard is used), and as soon as the breech is opened removes the old primer, clears the vent, and cleans the primer seat. Note.—(The battery commander may require Nos. 1 and 2 to assist in ramming the powder, and the chief of breech to assist in ramming the projectile.)	The chief of breech supervises unloading. Nos. 1 and 2 assist in withdrawing the dummy powder charge and the dummy projectile. No. 3 removes the primer.

8 or 10 inch gun drill (*disappearing carriage*)—Continued.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Rammer detail, No. 4.	No. 4 procures the rammer and places it on its hooks near the rail, head toward the hoist. He procures the extractor for the dummy projectile and places it near the rammer. He takes post about 2 yards from the head of the rammer, within reach of the staff, facing the piece.	No. 4 assists the breech detail in cleaning when necessary
Elevating detail, Nos. 5 and 6.	Nos. 5 and 6 take posts at the elevating handwheel on the same side as the range setter, facing the piece.	Nos. 5 and 6 assist the range setter in examining the elevating and retracting mechanism and in cleaning and oiling the gears.
Traversing detail, Nos. 7 and 8.	Nos. 7 and 8 procure the traversing cranks, place one of them on the shaft on the same side as the gun pointer, and take posts at the crank, facing to the rear.	Nos. 7 and 8 remove the drip pans and test the traversing mechanism. No. 8 receives the muzzle cover from No. 11 and places it at a designated place.
Tripping detail, Nos. 9 and 10.	No. 9 procures a wrench for filling plugs, a measure containing hydrolene oil, and a funnel, and goes to the right tripping lever. No. 10 procures a wrench for filling plugs and goes to the left tripping lever.	Nos. 9 and 10 mount on the chassis, each carrying a wrench, and remove the filling plugs from the recoil cylinders. If oil is needed, No. 9 calls on No. 11 for the funnel and measure and pours oil into the right cylinder slowly. No. 10 watches the oil hole in the left cylinder. When both cylinders are full, No. 9 hands the funnel and measure back to No. 11 and notifies the gun commander that the cylinders are ready for inspection. After the inspection, Nos. 9 and 10 screw the plugs well home and take posts, facing the piece, by the platform railing. No. 9 one yard to the right of No. 4 and No. 10 one yard to the left of No. 4.

8 or 10 inch gun drill (*disappearing carriage*)—Continued.

At command **LOAD**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
The truck is brought up to the face of the breech and the projectile pushed carefully off the truck until the base of the projectile is just inside the powder chamber. The truck is then withdrawn and run off to one side. Nos. 1, 2, 4, 9, and 10 then man the rammer as near the outer end as possible, and at the command **HOME RAM** by the chief of breech they rush the projectile forward hard into its seat, increasing the speed of the rush so that the projectile will have its fastest movement when it comes up hard in its seat. The rammer detail pushes the powder off the powder tray and into the powder chamber to such a distance that the breechblock will give the powder charge a final push into the chamber in closing. NOTE.—(The battery commander may require Nos. 1 and 2 to assist in ramming the powder, and the chief of breech to assist in ramming the projectile.)	No. 4 brings up the extractor and pulls the dummy powder sections back onto the powder tray. He hooks the extractor into the dummy projectile and assists in withdrawing it.
Nos. 5 and 6 elevate or depress the piece under direction of the range setter.	No duties.
Nos. 7 and 8 traverse the piece under direction of the gun pointer. They halt when the piece is fired and resume traversing as soon as the truck is withdrawn from the breech.	No duties.
Nos. 9 and 10 assist in ramming the projectile. As soon as the projectile is seated they quit the rammer and run to the tripping levers. At the command **IN BATTERY** they seize the tripping levers, and at the command **TRIP**, raise them quickly to the stops, hold them for an instant, then let go, and when the gun is in battery run back to their posts at the rammer, where they stand by for the next shot. If firing by electricity, No. 9 (or 10) closes the safety switch as soon as the gun is in battery.	No duties unless the dummy projectile sticks, in which case they assist in starting it from its seat.

8 or 10 inch gun drill (disappearing carriage)—Continued.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Truck detail, Nos. 11 and 12.	Nos. 11 and 12 bring out the shot trucks to be used and take posts at the handles of one of the trucks; No. 11 on the right and No. 12 on the left.	No. 11 removes the muzzle cover, hands it to No. 8, and assists No. 9 in filling the recoil cylinders, passing up the oil measure and the funnel when needed. Nos. 11 and 12 examine the trucks, clean and oil them when necessary. They then turn them over to the hoist detail for loading. When the first truck is loaded, they push it out to some convenient position in rear of the breech.
Powder serving detail, Nos. 13, 14, 15, and 16.	Nos. 13, 14, 15, and 16 bring out the powder trays to be used and turn them over to the ammunition detachment. They take posts opposite the first tray, loaded. Nos. 13 and 15 on the right and Nos. 14 and 16 on the left; Nos. 13 and 14 in rear.	Nos. 13, 14, 15, and 16 see that the powder sections are arranged on the trays in the order in which they are to be inserted.
Hoist detail, Nos. 17, 18, and 19. No. 17 is chief of detail unless a noncommissioned officer is assigned in charge.	Nos. 17, 18, and 19 take posts at the delivery table.	Nos. 17, 18, and 19 examine and clean the delivery table and the projectiles on it. They examine the automatic stop. They load the trucks turned over to them by the truck detail.
Sponge detail, No. 20.	No. 20 procures the chamber sponge and a vessel containing hydrolene oil, places them near the railing on the opposite side of the emplacement from the rammer, and takes post near the chamber sponge, facing the gun. (If there is to be no firing, the vessel may be empty.)	No. 20 brings up the chamber sponge when called for and assists in sponging the chamber.

8 or 10 inch gun drill (disappearing carriage)—Continued.

At command **LOAD**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
Nos. 11 and 12 run out a loaded shot truck, No. 12 adjusting the truck to the proper height in accordance with the position of the piece upon recoil. The truck is run forward so that the tray enters the breech recess squarely. As the truck brings up against the face of the breech No. 12 sets the brake. As soon as the projectile is pushed off the truck Nos. 11 and 12 run the truck back to the hoist, and turn it over to the hoist detail. Then they take posts behind a loaded truck and stand by for the next shot.	Nos. 11 and 12 push a truck into position at the breech to receive the dummy projectile, then return the truck to the loading position.
As soon as the rammer has been withdrawn after seating the projectile, the nose of the powder tray is inserted in the breech by Nos. 13, 14, 15, and 16, and the rammer detail, in one motion, pushes carefully the entire powder charge off the tray to such a distance that the breech block will give the powder charge a final push into the chamber in closing. The tray is then removed and the breech closed.	Nos. 13, 14, 15, and 16 bring up an empty powder tray to receive the dummy powder sections, and return the loaded tray to the loading position.
Nos. 17, 18, and 19 receive the empty truck after each shot, load it, and run it out conveniently for Nos. 11 and 12.	No duties.
No. 20 dips the chamber sponge in the hydrolene oil and allows the excess oil to run off. As soon as the breech block is opened after each shot, assisted by the breech detail, he sponges the chamber as quickly as practicable.	No duties.

NOTES ON THE DRILL.

157. The notes on the drill of the 12-inch or 14-inch gun battery, disappearing carriage, apply to an 8-inch or 10-inch gun battery, disappearing carriage, except that—

(*a*) The duties prescribed for Nos. 22 and 23 are omitted.

(*b*) The duties prescribed for No. 21 are omitted except those pertaining to retraction, and those prescribed in Par. 140, which are performed by No. 3.

Chapter X.

6-INCH GUN DRILL (DISAPPEARING CARRIAGE).

THE GUN SECTION.

158. Each emplacement is manned by a gun section (22 enlisted men plus the reserve detachment) consisting of a gun detachment, an ammunition detachment, and a reserve detachment. The gun commander is in command of the gun section, and is also chief of the gun detachment.

159. The gun detachment (15 enlisted men) consists of the gun commander, the gun pointer, the range setter, the range recorder, the deflection recorder, and 10 cannoneers, numbered from 1 to 10, inclusive. The gun detachment is divided into details as shown in the drill which follows.

160. The ammunition detachment (7 enlisted men) consists of the chief of ammunition and 6 cannoneers, numbered from 11 to 16, inclusive. The ammunition detachment is divided into details for the service of powder and projectiles according to the location of magazines and shot rooms pertaining to the emplacement.

161. The reserve detachment consists of all unassigned cannoneers. It is divided into two reserve details, one for the gun detachment and one for the ammunition detachment. The reserve detachment is posted by the gun commander at some convenient place or places, and is used by him to fill vacancies in the other detachments.

162. To post the gun section.—The section is posted as prescribed in detail in paragraph 40. The gun commander commands **DETAILS, POSTS,** and after the cannoneers are posted he commands **EXAMINE GUN.**

163. To call off.—The battery commander may at any time give the command **CALL OFF,** which is repeated by the gun commander. The cannoneers call off their numbers beginning at 1.

164. To load and fire.—The battery commander indicates the target as prescribed in Chapter V. He designates the kind of projectile to be used, and after tracking has begun commands:

(*a*) **COMMENCE FIRING.**

(*b*) **FIRE ——— ROUNDS, COMMENCE FIRING.**

(*c*) **NUMBER(S) ——— FIRE ——— SHOTS, COMMENCE FIRING.**

The gun commander commands **LOAD** when the battery commander gives the command **COMMENCE FIRING,** and before each shot of a series.

The battery commander may give the command **LOAD,** in which case the gun commander repeats the command. The piece is loaded, but is held from battery until the battery commander commands **COMMENCE FIRING.**

When the number of rounds specified has been fired, the gun commander commands **CEASE FIRING**, at which command all cannoneers resume their posts.

When the number of rounds is not specified, the battery commander commands **CEASE FIRING**, and the gun commander repeats the command.

165. When dummy ammunition is used, the piece is unloaded at the command **CEASE FIRING**, unless otherwise ordered.

166. The following drill is prescribed:

6-inch gun drill (disappearing carriage).

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Gun commander (noncommissioned officer).	The gun commander gives the command **DETAILS, POSTS**, and supervises the procuring of equipments and implements. He posts the reserve detachment.	The gun commander gives the command **EXAMINE GUN**, makes a general inspection of the gun and carriage, and reports to the emplacement officer.
Gun pointer (noncommissioned officer or private).	The gun pointer procures the sight, places it in its seat, and takes post on the sighting platform.	The gun pointer examines the sight and verifies the adjustment of the azimuth index. He examines the traversing mechanism and the electric firing mechanism and circuit (if used).
Range setter (noncommissioned officer or private).	The range setter takes post facing the range scale.	The range setter examines the elevating and retracting mechanisms. He cleans and oils the gears.
Range recorder (noncommissioned officer or private).	The range recorder procures chalk, a ruler, a blackboard eraser, and a stop watch, and takes post at the time-range board.	The range recorder examines the time-range board. He puts on the head set and tests the telephone to the plotting room.
Deflection recorder (noncommissioned officer or private).	The deflection recorder procures chalk and a blackboard eraser, and takes post at the deflection recorder's board.	The deflection recorder examines the deflection recorder's board. He puts on the head set and tests the telephone to the plotting room.
Breech detail, Nos. 1, 2, and 3. No. 3 is the chief of breech.	No. 1 procures a wiper or cotton waste and a can containing lubricating oil, and a sponge. He places the can convenient to the breech and takes post about 2 feet to the rear and right of the breech, facing it. No. 2 procures the loading tray (if one is used) and a wiper or cotton waste. He places the tray convenient to the breech and takes post about 2 feet to the rear and left of the breech, facing it. No. 3 procures the lanyard (when one is used), primers, primer pouch, punch, drill, reamer, and firing mechanism, and takes post about 2 feet to the right of the breech on line with its face, facing it.	No. 1 removes the breech cover and places it at the designated place. He examines, cleans, and oils the breechblock and breech mechanism. No. 2 examines, cleans, and oils the breech recess and gas-check seat. No. 3 examines the vent and the firing mechanism. He clears the vent and cleans the primer seat. He examines the chamber and bore and gives the necessary orders for cleaning them.

6-inch gun drill (disappearing carriage).

At command **LOAD**.	At command **CEASE FIRING** (when dummy ammunition is used).
The gun commander gives the command **LOAD** and supervises the work of his section. After No. 3 has given the command **TRIP**, the gun commander sees that the gun goes fully into battery, verifies the range setting, and if the setting is correct, calls **READY**.	The gun commander gives the command **CEASE FIRING** and supervises the work of unloading.
The gun pointer sets the deflection recorded on the deflection recorder's board and directs the traversing so that he will be on the target by the time the gun is in battery. He fires the piece or gives the command **FIRE** as soon after the command **READY** as the piece is pointed.	No duties.
At the command **TRIP** the range setter lays the piece for range in accordance with information obtained from the time-range board, as described in par. 400.	No duties.
The range recorder continues plotting the time-range curve.	The range recorder continues plotting the time-range curve.
The deflection recorder makes a record of the last deflection received when it differs from the last one recorded, erasing the latter.	The deflection recorder continues recording deflections.
No. 1 opens breech, cleans and oils the block when necessary, and as soon as the powder charge has been inserted he closes the breech. When the piece is fired he seizes the lever handle as soon as the gun has recoiled within reach and opens the breech for the next charge.	No. 1 opens breech.
No. 2 unhooks the lanyard (if one is used) after the piece is fired. When the breech has been opened he wipes the mushroom head and the gas-check seat with a cloth moistened with hydrolene oil and puts the loading tray in place. He withdraws the loading tray after the projectile has been rammed to permit insertion of the powder tray, and pushes the powder into the chamber by hand from the tray just far enough so that the breech block will give the powder charge a final push in closing. No. 3 inserts a primer after the breechblock is completely closed and lowers the leaf of the firing device completely down. He hooks the lanyard (if one is used) before the primer is inserted, commanding **IN BATTERY** in time to add **TRIP** after the primer is inserted. As the gun goes in battery he steps to the rear and right and pulls the lanyard (if one is used) at the command **FIRE**. As soon as the breech is opened after firing he removes the old primer, clears the vent, and cleans the primer seat.	No. 2 withdraws the dummy powder charge. No. 3 removes the primer.

6-inch gun drill (disappearing carriage)—Continued.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Rammer detail, No. 4.	No. 4 procures the rammer and takes post about 4 feet in rear of the breech, facing it. He holds the rammer in his right hand, in a vertical position, its head on the platform by his right foot.	No. 4 assists the breech detail in cleaning when necessary.
Projectile detail, Nos. 5 and 6.	No. 5 takes post near the serving table. No. 6 procures the extractor for dummy projectile, places it at the designated place, and takes post near the serving table.	No. 5 assists No. 7 in filling the recoil cylinders, unscrewing, and after inspection replacing the filling plug on the side of the carriage opposite to the post of No. 7. When called for by No. 7, No. 5 passes to him the funnel and the measure containing hydrolene oil, and receives them back from No. 7 when the cylinders have been filled. No. 6 removes the muzzle cover and places it at the designated place. He then assists the range setter in examining the elevating and retracting mechanisms and in cleaning and oiling the gears.
Tripping detail, No. 7.	No. 7 procures the wrench for filling plugs, a measure containing hydrolene oil, and a funnel, and takes post at the tripping lever which is nearer the safety switch.	No. 7 unscrews the filling plug on his side of the gun, and if oil is needed calls on No. 5 for the funnel and measure and pours oil into his cylinder slowly. When both cylinders are full he hands the funnel and measure back to No. 5 and notifies the gun commander that the cylinders are ready for inspection. After this inspection, he screws both plugs well home and replaces his implements.
Powder serving detail, Nos. 8 and 9.	Nos. 8 and 9 procure two powder trays and take post, each with a tray, at that point of the loading platform most convenient to the source of powder supply.	Nos. 8 and 9 remove the drip pans and inspect the powder trays.
Sponge detail, No. 10.	No. 10 procures the chamber sponge and a vessel containing hydrolene oil, places them near the railing, and takes post near the chamber sponge, facing the gun. (If there is to be no firing the vessel may be empty.)	No. 10 brings up the chamber sponge when called for and sponges the chamber.

6-inch gun drill (*disappearing carriage*)—Continued.

At command **LOAD.**	At command **CEASE FIRING** (when dummy ammunition is used).
As soon as a projectile is launched on the loading tray, No. 4 rushes the projectile forward hard into its seat, using all possible force and continually increasing speed until the projectile is seated.	No. 4 brings up the extractor and withdraws the dummy projectile to where it can be seized by No. 5 or 6.
Nos. 5 and 6 alternately pick up projectiles from the serving table and insert them in the breech. The number not loading a projectile arranges the remaining projectiles on the serving table, and keeps the table convenient to the breech.	Nos. 5 and 6 alternately remove dummy projectiles from the breech recess where No. 4 has left them, and place them on the serving table.
No. 7 raises the tripping levers at the command **TRIP** of No. 3, and if firing by electricity closes the safety switch as soon as the gun is in battery.	No. duties.
Nos. 8 and 9 alternate in serving powder to the gun. The end of the powder tray is placed in the breech recess after the loading tray has been removed, and No. 2 pushes the powder into the chamber by hand.	Nos. 8 and 9 alternate in bringing up empty powder trays to receive the dummy powder charges.
No. 10 dips the chamber sponge in the hydrolene oil and allows the excess oil to run off. As soon as the breechblock is opened after each shot, he sponges the chamber as quickly as practicable.	No duties.

NOTES ON THE DRILL.

167. To retract the gun.—To bring the gun from the firing to the loading position by hand the gun commander commands (1) **FROM BATTERY**, (2) **HEAVE**, (3) **HALT**. At the first command No. 7 goes to the retraction crank, releases the retaining pawl and turns the speed crank to permit the pulling out of the cables. Nos. 5 and 6 mount on the carriage. Nos. 1 and 2 pull out the cables and pass the ends to Nos. 5 and 6, who place the loops of the cables on the hooks. No. 7 takes in the slack. Nos. 8 and 9 take positions at the retraction crank, and at the second command turn the crank. Nos. 5 and 6 relieve Nos. 8 and 9 when directed by the gun commander. When the gun has reached the loading position, the command **HALT** is given. At this command, No. 7 lets out enough slack to enable Nos. 1 and 2 to take the loops off the hooks.

Chapter XI.

12-INCH GUN DRILL (BARBETTE CARRIAGE).

THE GUN SECTION.

168. Each emplacement is manned by a gun section (42 enlisted men plus the reserve detachment) consisting of a gun detachment, an ammunition detachment, and a reserve detachment. The gun commander is in command of the gun section, and is also chief of the gun detachment.

169. The gun detachment (29 enlisted men) consists of the gun commander, the gun pointer, the chief of breech, the range setter, the range recorder, the deflection recorder, and 23 cannoneers, numbered from 1 to 23, inclusive. The gun detachment is divided into details, as shown in the drill which follows.

170. The ammunition detachment (13 enlisted men) consists of the chief of ammunition and 12 cannoneers, numbered from 24 to 35, inclusive. The ammunition detachment is divided into details for the service of powder and projectiles according to the location of magazines, shot rooms, and hoists pertaining to the emplacement.

171. The reserve detachment consists of all unassigned cannoneers. It is divided into two reserve details, one for the gun detachment and one for the ammunition detachment. The reserve detachment is posted by the gun commander at some convenient place or places, and is used by him to fill vacancies in the other detachments.

172. To post the gun section.—The section is posted as described in detail in paragraph 40. The gun commander commands **DETAILS, POSTS**, and after the cannoneers are posted, he commands **EXAMINE GUN**.

173. To call off.—The battery commander may at any time give the command **CALL OFF**, which is repeated by the gun commander. The cannoneers call off their numbers, beginning at 1.

174. To load and fire.—The battery commander indicates the target, as prescribed in Chapter V. He designates the kind of projectile to be used, and after tracking has begun, commands:

(*a*) **COMMENCE FIRING.**

(*b*) **FIRE ——— ROUNDS, COMMENCE FIRING.**

(*c*) **NUMBER(S) ——— FIRE ——— SHOTS, COMMENCE FIRING.**

The gun commander commands **LOAD** when the battery commander gives the command **COMMENCE FIRING**, and before each shot of a series.

The battery commander may give the command **LOAD**, in which case the gun commander repeats the command. The piece is loaded, but not fired until the battery commander commands **COMMENCE FIRING**.

When the number of rounds specified has been fired the gun commander commands **CEASE FIRING**, at which command all cannoneers resume their posts.

When the number of rounds is not specified, the battery commander commands **CEASE FIRING**, and the gun commander repeats the command.

175. When dummy ammunition is used, the piece is unloaded at the command **CEASE FIRING**, unless otherwise ordered.

176. The following drill is prescribed:

12-inch gun drill (barbette carriage).

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Gun commander (noncommissioned officer).	The gun commander gives the command **DETAILS, POSTS**, and supervises the procuring of equipment and implements. He posts the reserve detachment.	The gun commander gives the command **EXAMINE GUN**, makes a general inspection of gun and carriage, and reports to the emplacement officer.
Gun pointer (noncommissioned officer or private).	The gun pointer procures the sight, places it in its seat, and takes post on the sighting platform.	The gun pointer examines the sight and verifies the adjustment of the azimuth index. He examines the traversing mechanism and the electric firing mechanism and circuit (if used).
Range setter (noncommissioned officer or private).	The range setter takes post on the range setter's platform.	The range setter examines the elevating mechanism, and cleans and oils the gears, if necessary.
Range recorder (noncommissioned officer or private).	The range recorder procures chalk, a ruler, a blackboard eraser, and a stop watch, and takes post at the time-range board.	The range recorder inspects the time-range board. He puts on the head set and tests the telephone to the plotting room.
Deflection recorder (noncommissioned officer or private).	The deflection recorder procures chalk and blackboard eraser and takes post at the deflection recorder's board.	The deflection recorder inspects his board. He puts on the head set and tests the telephone to the plotting room.

12-inch gun drill (barbette carriage).

At command **LOAD.**	At command **CEASE FIRING** (when dummy ammunition is used).
The gun commander gives the command **LOAD** and supervises the work of his section. If the piece is ready for firing when the range setter calls **RANGE SET**, he commands **READY**.	The gun commander gives the command **CEASE FIRING** and supervises the work of unloading.
The gun pointer sets the deflection recorded and directs the traversing so as to follow the target. He fires the piece or gives the command **FIRE** as soon after the command **READY** as the piece is pointed.	No duties.
The range setter lays the piece for range in accordance with information obtained from the time-range board as described in par. 400. He then calls **RANGE SET**. He directs the work of Nos. 5 and 6, requiring the piece to be brought to an approximately horizontal position after each shot. (NOTE.—When available, the battery commander may detail an extra noncommissioned officer to check the range.)	The range setter directs the piece to be brought to an approximately horizontal position.
The range recorder continues plotting the time-range curve as prescribed in par. 400.	The range recorder continues plotting the time-range curve.
The deflection recorder makes a record of the last deflection received when it differs from the preceding one, erasing the latter.	The deflection recorder continues recording deflections.

12-inch gun drill (barbette carriage)—**Continued.**

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Breech detail, chief of breech (noncommissioned officer or private) and Nos. 1, 2, and 3.	The chief of breech takes post 1 yard in rear of No. 2. No. 1 procures the translating roller, a wiper or cotton waste, a can containing lubricating oil and a sponge; he places the can convenient to the breech, the translating roller in position, and takes post on the loading platform immediately to the rear and on the right of the breech, facing it. No. 2 procures a wiper or cotton waste and the loading tray; he places the tray convenient to the breech and takes post to the left of No. 1, facing the breech. No. 3 procures the lanyard (if one is used), primers, primer pouch, punch, drill, reamer, and firing mechanism, and takes post on the platform to the right of No. 1, facing the breech.	The chief of breech examines the breech mechanism, breechblock, breech recess, chamber, and bore, and gives the necessary orders for cleaning and putting them in condition for service. No. 1 removes the breech cover and passes it to No. 4. He cleans and oils the breechblock and mechanism. No. 2 cleans and oils the breech recess and gas check seat. No. 3 examines the vent and firing mechanism. He clears the vent and cleans the primer seat. He frees the lanyard (if one is used) of kinks and hangs it on a hook outside the platform rail on the right side of the carriage.
Rammer detail, Nos. 4, 20, and 21.	No. 4 procures the rammer and places it on the prop. No. 21 procures the extractor for the dummy projectile and places it near the rammer. Nos. 4 and 21 take post in rear of the loading platform, No. 4 on the right and No. 21 on the left. No. 20 procures the chamber sponge and places it on the prop. He procures a vessel containing hydrolene oil and places it in rear of the loading platform to the right of the prop, and takes post in rear of Nos. 4 and 21. (When firing is not to take place the vessel may be empty.)	Nos. 4 and 21 assist the breech detail in cleaning when necessary. No. 20 passes up the sponge called for, receives it back and assists in sponging when necessary.

12-inch gun drill (barbette carriage)—Continued.

At command **LOAD**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
The chief of breech sees that the projectile is pushed carefully off the tray until its base is just inside the powder chamber, and commands **HOME RAM**, when the projectile is rushed forward hard into its seat, the ramming detail increasing the speed of the rush so that the projectile will have its fastest movement when it comes into its seat. He assists in ramming the projectile, withdraws the rammer, and assists in ramming the first three sections of powder; he hooks the lanyard (if one is used) before the primer is inserted, holds the lanyard until No. 3 has stepped clear of the recoil, and then steps clear of the recoil. After the piece is fired he unhooks the lanyard (if one is used), assists in sponging, and returns the sponge to No. 20. No. 1 receives the rammer and places its head against the base of the projectile, assists in ramming the projectile and powder charge, inserts the first and third sections of powder, closes the breech, and steps clear of the recoil. After the piece is fired he receives the chamber sponge from No. 20, assists in sponging the chamber, wipes off the breechblock, and oils the threads. No. 2 inserts the loading tray, swings the projectile into position, assists in ramming the projectile, inserts the second and fourth sections of the powder charge, seeing that the last section is left so that it will be pushed into place by the mushroom-head, removes the loading tray, and steps clear of the recoil. After the piece is fired he wipes off the gas-check seat and breech recess. No. 3 opens breech. After the breech has been fully closed, rotated, and lanyard (if one is used) hooked, he inserts the primer, lowers the firing leaf, and steps clear of the recoil. After the piece has been fired he prepares the vent while the piece is being loaded.	The chief of breech supervises. No. 1 passes the first and third sections of dummy powder to Nos. 14 and 16, and assists in withdrawing the dummy projectile. No. 2 inserts the loading tray as soon as the breech is opened and passes the second and fourth sections of dummy powder to Nos. 13 and 15, assists in withdrawing the dummy projectile and in swinging it clear of the platform. No. 3 opens breech, removes the primer, and assists in withdrawing the dummy projectile.
No. 4, assisted by No. 21, tosses up the rammer so it can be seized by No. 1, mounts on the loading platform, assists in ramming the projectile and powder charge, dismounts, takes the end of the lanyard (if one is used) and pulls it at the command **FIRE**. No. 20 passes the chamber sponge to No. 1 immediately after the piece has been fired; he receives it back from the chief of breech and places it on the prop. (During firing he keeps the sponge head in hydrolene oil while the piece is being loaded.) He places the rammer, received from No. 21, on the prop. No. 21 mounts on the loading platform after he has passed up the rammer, assists in ramming the projectile and powder charge, passes the rammer back to No. 20, and dismounts.	No. 4 mounts on the loading platform, receives the extractor from No. 20, pulls back the dummy powder sections, assists in withdrawing the dummy projectile, and returns the extractor to No. 20. No. 20 passes the extractor to No. 4, receives it back from him, and places it on the prop. No. 21 mounts on the loading platform and assists in withdrawing the dummy projectile.

12-inch gun drill (barbette carriage)—Continued.

Details.	At command **DETAILS, POSTS**.	At command **EXAMINE GUN**.
Elevating detail; Nos. 5 and 6.	No. 5 takes post at the elevating handwheel on the right side of the carriage, facing it. No. 6 takes post at the elevating handwheel on the left side of the carriage, facing it.	Nos. 5 and 6 assist the range setter in examining the elevating mechanism, and in cleaning and oiling the gears.
Traversing detail; Nos. 7 and 8.	Nos. 7 and 8 procure the traversing cranks, place them on the shaft and take post thereat.	Nos. 7 and 8 remove the drip pans and assist in testing the traversing mechanism.
Hoist tackle detail; Nos. 9, 10, 22, and 23. No. 9 is chief of detail unless a noncommissioned officer is assigned in charge.	No. 9 procures the wrench for filling plugs, a measure containing hydrolene oil, and a funnel, and takes post opposite the hoist tackle, one yard from and facing the piece. No. 10 procures a wrench for the filling plugs, and takes post in rear of the windlass crank handle, facing it. No. 22 takes post on the left of No. 10. No. 23 takes post in front of the windlass crank handle, facing it.	Nos. 9 and 10 mount on the chassis, each carrying a wrench, and remove the filling plugs from the recoil cylinders. If oil is needed, No. 9 calls on No. 23 for the funnel and measure and pours oil into the right cylinder, slowly; No. 10 watches the oil in the left cylinder. When both cylinders are full No. 9 hands the funnel and measure back to No. 23 and notifies the gun commander that the cylinders are ready for inspection. After the inspection Nos. 9 and 10 screw the filling plugs well home and replace their implements. No. 22 examines the tackle on the hoisting gears and cleans and oils the parts. No. 23 removes the muzzle cover, places it at the designated place and assists No. 9 in filling the recoil cylinders, passing up the funnel and oil measure when needed.
Truck detail; Nos. 11 and 12.	Nos. 11 and 12 bring out shot trucks to be used and take post at the handles of the first truck, No. 11 on the right and No. 12 on the left.	Nos. 11 and 12 examine the trucks, and clean and oil them when necessary. They then turn them over to the hoist detail for loading. When the first truck is loaded, they push it to a position immediately under the hoisting tackle on the carriage.
Powder serving detail; Nos. 13, 14, 15, and 16.	All take posts at the station designated for the battery.	No duties.

12-inch gun drill (*barbette carriage*)—Continued.

At command **LOAD**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
Nos. 5 and 6 elevate and depress the piece under the direction of the range setter.	Nos. 5 and 6 depress the piece as directed by the range setter.
Nos. 7 and 8 traverse the piece under the direction of the gun pointer.	No duties.
No. 9 hooks the hoist tackle to the shot tongs, commands **HOIST**, and steadies the projectile as it rises, mounts the steps, commands **HALT** when the projectile is at the height of the breech. He assists in swinging the projectile around to the breech, unfixes the shot tongs, and swings them clear of the loading platform. He commands **LOWER**, passes the empty shot tongs to No. 20, and hooks the tackle to the shot tongs of another projectile. He directs the work of the hoist detail so as to have a projectile hoisted to the proper height by the time the piece is fired. Nos. 10 and 22 assist in hoisting the projectile. No. 23 assists in hoisting the projectile, lowers the shot tongs, and attends to the pawl.	No. 9 swings the shot tongs over the projectile, assists in swinging the projectile clear of the loading platform, and commands **LOWER**. Nos. 10, 22, and 23 lower the dummy projectile onto the truck.
As soon as the first projectile is hoisted, Nos. 11 and 12 pull the empty truck aside and push the second truck under the hoist tackle. Then they return with the empty truck to the ammunition hoist, turn it over to the ammunition hoist detail, and take post behind a loaded truck. As soon as the piece is fired they run this truck rapidly to the position described under "**DETAILS, POSTS**" for the second truck, pull the empty truck away from the hoisting tackle, and proceed as above.	Nos. 11 and 12 push a truck into position under the hoist tackle.
Nos. 13, 14, 15, and 16 move at a run, each with a section of the powder charge, passing them up to Nos. 1 and 2 on the loading platform, and return to their posts.	Nos. 13, 14, 15, and 16 each receive a section of the dummy powder charge and return them to their posts.

12-inch gun drill (barbette carriage)—Continued.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Hoist detail; Nos. 17, 18, and 19. No. 17 is chief of detail unless a noncommissioned officer is assigned in charge.	Nos. 17, 18, and 19 take post at the delivery table.	Nos. 17, 18, and 19 examine and clean the delivery table, and the projectiles on it. They examine the automatic stop. They load the trucks turned over to them by the truck detail.

12-inch gun drill (barbette carriage)—Continued.

At command **LOAD**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
Nos. 17, 18, and 19 receive the empty truck after each shot, load it, and run it out conveniently for Nos. 11 and 12.	No duties.

NOTES ON THE DRILL.

(See also Chapters V, XV, and XVI.)

177. To open and close breech.—The breech must not be opened until the piece has been depressed to an approximately horizontal position; when open, the piece must not be elevated until the breech block is swung to the left in the operation of closing breech.

178. To open breech (1888 mechanism).—No. 3 releases the rotating crank by turning the rotating crank catch to the left and turning the rotating crank clockwise as indicated by the "open" arrow until it brings up short in a horizontal position and is secured by its catch; he then briskly turns the translating crank contraclockwise. When the shoulders of the grooves strike against the ends of the rails, the block stops short and the shock frees the tray latch from its catch, and the tray and block are swung to the right until the securing latch engages in the catch.

179. To close the breech (1888 mechanism).—No. 1 releases the securing latch from the catch, assisted by No. 3 swings the tray and block around smartly to the left, seizes the handle of the tray, and continues the swinging of the block until the tray abuts against and is latched to the face of the breech; he then turns the translating crank clockwise until the block is translated completely; releases the rotating crank by turning the rotating crank catch to the left, and turns the rotating crank contraclockwise, as indicated by the "close" arrow, until it brings up short in a vertical position and is secured by its catch.

Chapter XII.

8 OR 10 INCH GUN DRILL (BARBETTE CARRIAGE).

180. The drill for the 8-inch or 10-inch gun (barbette carriage) is the same as that for the 12-inch gun (barbette carriage) with the following exceptions:

The gun detachment consists of 20 cannoneers instead of 23; Nos. 21, 22, and 23 being omitted. No. 4, instead of No. 21, passes the rammer to No. 20. No. 10, instead of No. 22, examines the tackle on the hoisting gears. No. 8, instead of No. 23, removes the muzzle cover and passes the funnel and measure to and receives them from No. 9 when the recoil cylinders are filled.

The ammunition detachment consists of 10 cannoneers (instead of 12), whose numbers run from 21 to 30, inclusive.

Chapter XIII.

5 OR 6 INCH GUN DRILL (BARBETTE CARRIAGE).

THE GUN SECTION.

181. Each emplacement is manned by a gun section (21 enlisted men plus the reserve detachment) consisting of a gun detachment, an ammunition detachment, and a reserve detachment. The gun commander is in command of the gun section, and is also chief of the gun detachment.

182. The gun detachment (14 enlisted men) consists of the gun commander, the gun pointer, the range setter, the range recorder, the deflection recorder, and 9 cannoneers, numbered from 1 to 9, inclusive. The gun detachment is divided into details as shown in the drill which follows.

183. The ammunition detachment (7 enlisted men) consists of the chief of ammunition and 6 cannoneers, numbered from 10 to 15, inclusive. The ammunition detachment is divided into details for the service of powder and projectiles according to the location of magazines, shot rooms, and hoists pertaining to the emplacement.

184. The reserve detachment consists of all unassigned cannoneers. It is divided into two reserve details, one for the gun detachment and one for the ammunition detachment. The reserve detachment is posted by the gun commander at some convenient place or places, and is used by him to fill vacancies in the other detachments.

185. To post the gun section.—The section is posted as prescribed in detail in paragraph 40. The gun commander commands **DETAILS, POSTS**, and after the cannoneers are posted, he commands **EXAMINE GUN.**

186. To call off.—The battery commander may at any time give the command **CALL OFF**, which is repeated by the gun commander. The cannoneers call off their numbers beginning at 1.

187. To load and fire.—The battery commander indicates the target as prescribed in Chapter V. He designates the kind of projectile to be used, and after tracking has begun, commands:

(*a*) **COMMENCE FIRING.**

(*b*) **FIRE ——— ROUNDS, COMMENCE FIRING.**

(*c*) **NUMBER(S) ——— FIRE ——— SHOTS, COMMENCE FIRING.**

The gun commander commands **LOAD** when the battery commander gives the command **COMMENCE FIRING**, and before each shot of a series.

The battery commander may give the command **LOAD**, in which case the gun commander repeats the command. The piece is loaded, but is not fired until the battery commander commands **COMMENCE FIRING**.

When the number of rounds specified has been fired the gun commander commands **CEASE FIRING**, at which command all cannoneers resume their posts.

When the number of rounds is not specified, the battery commander commands **CEASE FIRING**, and the gun commander repeats the command.

188. When dummy ammunition is used, the piece is unloaded at the command **CEASE FIRING**, unless otherwise ordered.

189. The following drill is prescribed:

5 or 6 inch gun drill (barbette carriage).

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Gun commander (noncommissioned officer).	The gun commander gives the command **DETAILS, POSTS** and supervises the procuring of equipments and implements. He posts the reserve detachment.	The gun commander gives the command **EXAMINE GUN**, makes a general inspection of the gun and carriage, and reports to the emplacement officer.
Gun pointer (noncommissioned officer or private).	The gun pointer procures the sight, places it in its seat, and takes post on the sighting platform.	The gun pointer examines the sight. He examines the traversing mechanism and the electric firing mechanism and circuit (if used).
Range setter (noncommissioned officer or privtse).	The range setter takes post facing the range scale.	The range setter tests the elevating mechanism. He cleans and oils the gears.
Range recorder (noncommissioned officer or private).	The range recorder procures chalk, a ruler, a blackboard eraser, and a stop watch, and takes post at the time-range board.	The range recorder examines the time-range board. He puts on the head set and tests the telephone to the plotting room.
Deflection recorder (noncomsioned officer or private).	The deflection recorder procures chalk, and a blackboard eraser, and takes post at the deflection recorder's board.	The deflection recorder examines the deflection recorder's board. He puts on the head set and tests the telephone to the plotting room.
Breech detail, Nos. 1, 2, and 3. No. 3 is the chief of breech.	No. 1 procures a wiper or cotton waste and a can containing lubricating oil and a sponge. He places the can convenient to the breech and takes post about 2 feet to the rear and right of the breech, facing it. No. 2 procures a loading tray (if one is used) and a wiper or cotton waste. He places the tray convenient to the breech and takes post about 2 feet to the rear and left of the breech, facing it. No. 3 procures the lanyard (if one is used), primers, primer pouch, punch, drill, reamer, and firing mechanism and takes post about 2 feet to the right of the breech on line with its face, facing it.	No. 1 removes the breech cover and places it at the designated place. He examines, cleans, and oils the breechblock and breech mechanism. No. 2 examines, cleans, and oils the breech recess and gas check seat. No. 3 examines the vent and the firing mechanism. He clears the vent and cleans the primer seat. He examines the chamber and bore and gives the necessary orders for cleaning them.
Rammer detail, No. 4.	No. 4 procures the rammer and takes post about 4 feet in rear of the breech, facing it. He holds the rammer in a vertical position with his right hand, its head on the platform by his right foot.	No. 4 assists the breech detail in cleaning when necessary.

5 or 6 inch gun drill (barbette carriage).

At command **LOAD**.	At command **CEASE FIRING** (when dummy ammunition is used).
The gun commander gives the command **LOAD** and supervises the work of his section. He verifies the range setting, and if the setting is correct calls **READY**.	The gun commander gives the command **CEASE FIRING** and supervises the work of unloading.
The gun pointer sets the deflection received and follows the target continuously. He fires the piece (or gives the command **FIRE**) as soon after the command **READY** as the piece is pointed.	No duties.
The range setter lays the piece for range in accordance with data obtained from the time-range board, as prescribed in paragraph 400.	No duties.
The range recorder continues plotting the time-range curve, as prescribed in paragraph 400.	The range recorder continues plotting the time-range curve.
The deflection recorder makes a record of the last deflection received when it differs from the last one recorded, erasing the latter.	The deflection recorder continues recording deflections.
No. 1 opens breech, cleans and oils the block, when necessary, and as soon as the powder charge has been inserted he closes breech. He seizes the lever handle as soon as possible after the piece is fired and opens breech for the next shot. No. 2 unhooks the lanyard (if one is used) after the piece is fired. When the breech has been opened he wipes the mushroom head and the gas-check seat with a cloth moistened with hydrolene oil and he puts the loading tray in place. He withdraws the loading tray after the projectile has been rammed to permit insertion of the powder tray, and pushes the powder into the chamber by hand from the tray. No. 3 inserts a primer after the breechblock is completely closed and lowers the leaf of the firing device completely down. He hooks the lanyard (if one is used) before the primer is inserted and pulls the lanyard at the the command **FIRE**. As soon as the breech is opened after firing, he removes the old primer, clears the vent, and cleans the primer seat.	No. 1 opens breech. No. 2 withdraws the dummy powder charge. No. 3 removes the primer.
At the command **HOME RAM** by the chief of breech, No. 4 rushes the projectile forward hard into its seat, increasing the speed of the rush so that the projectile will have its fastest movement when it comes up hard in its seat.	No. 4 brings up the extractor and withdraws the dummy projectile.

5 or 6 inch gun drill (*barbette carriage*)—Continued.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Projectile detail, Nos. 5 and 6.	No. 5 procures the wrench for filling plugs, a funnel, and a measure containing hydrolene oil, and takes these to the recoil cylinder. After completing his duties for **EXAMINE GUN**, he replaces his implements and takes post near the serving table, facing the piece. No 6 procures the extractor, for dummy projectiles, places it at the designated place, and takes post near the serving table.	No. 5 unscrews the filling plugs and if oil is needed pours it in until it stands in the filling hole, waits a moment to allow the escape of air, and pours in more, if necessary. Then he notifies the gun commander that the cylinders are ready for inspection. After the inspection No. 5 screws the plugs well home, replaces his implements, and takes post near the serving table, facing the piece. No. 6 removes the muzzle cover and places it at the designated place. He assists the range setter in examining the elevating mechanism and in cleaning and oiling the gears.
Powder serving detail, Nos. 7 and 8.	Nos. 7 and 8 procure two powder trays and take post, each with a tray, at that part of the loading platform most convenient to the source of powder.	Nos. 7 and 8 examine the powder trays.
Sponge detail, No. 9.	No. 9 procures the chamber sponge and a vessel containing hydrolene oil, places them near the railing, and takes post near the chamber sponge, facing the gun. (If there is to be no firing, the vessel may be empty.)	No. 9 brings up the chamber sponge when called for and sponges the chamber.

5 or 6 inch gun drill (*barbette carriage*)—Continued.

At command **LOAD**.	At command **CEASE FIRING**. (When dummy ammunition is used.)
Nos. 5 and 6 alternately pick up projectiles from the serving table and insert them in the breech. The number not loading a projectile arranges the remaining projectiles on the serving table, and keeps the table convenient to the breech.	Nos. 5 and 6 alternately remove dummy projectiles from the breech recess where No. 4 has left them and place them on the serving table.
Nos. 7 and 8 alternate in bringing up powder charges. The end of the powder tray is placed in the breech recess after the loading tray has been removed, and No. 2 pushes the powder into the chamber by hand.	Nos. 7 and 8 alternate in bringing up empty powder trays to receive the powder charges.
No. 9 dips the chamber sponge in the hydrolene oil and allows the excess oil to run off. As soon as the breechblock is opened after each shot, he sponges the chamber as quickly as practicable.	No duties.

Chapter XIV.

3-INCH, 4-INCH, OR 4.7-INCH GUN DRILL.

THE GUN SECTION.

190. Each emplacement is manned by a gun section (12 enlisted men plus the reserve detachment) consisting of a gun detachment, an ammunition detachment, and a reserve detachment. The gun commander is in command of the gun section, and is also chief of the gun detachment.

191. The gun detachment (6 enlisted men) consists of the gun commander, the gun pointer, the range setter, and three cannoneers numbered from 1 to 3, inclusive. The gun detachment is divided into details as shown in the drill which follows.

192. The ammunition detachment (6 enlisted men) consists of the chief of ammunition and 5 cannoneers, numbered from 4 to 8 inclusive. The ammunition detachment is divided into details according to the location of magazines and shot rooms pertaining to the emplacement.

193. The reserve detachment consists of all unassigned cannoneers. It is posted by the gun commander at some convenient place or places, and is used by him to fill vacancies in the other detachments.

194. To post the gun section.—The section is posted as prescribed in detail in paragraph 40. The gun commander commands **DETAILS, POSTS**, and after the cannoneers are posted, he commands **EXAMINE GUN**.

195. To call off.—The battery commander may at any time give the command **CALL OFF**, which is repeated by the gun commander. The cannoneers call off their numbers, beginning at one.

196. Method of firing.—Chapter VI describes the method of firing and of fire direction.

197. The following drill is prescribed:

3-inch, 4-inch, or 4.7-inch gun drill.

Details.	At command **DETAILS, POSTS.**	At command **EXAMINE GUN.**
Gun commander (noncommissioned officer).	The gun commander gives the command **DETAILS, POSTS**, and supervises the procuring of equipment and implements.	The gun commander gives the command **EXAMINE GUN**, makes a general inspection of the gun and carriage, and reports to the emplacement officer.
Gun pointer (noncommissioned officer or private).	The gun pointer procures the sight and places it in its seat and takes post in rear of the shoulder piece, facing to the front.	The gun pointer examines the sight and examines the traversing mechanism, the firing circuit (if one is installed) and the lanyard (if used).
Range setter (noncommissioned officer or private).	The range setter takes post near the range scale if the carriage is provided with one; otherwise at the elevating clamp, facing it.	The range setter tests the elevating mechanism and cleans and oils the gears.
Breech detail, Nos. 1 and 2; No. 1 is chief of breech.	No. 1 procures a wiper or cotton waste and a can containing lubricating oil and a sponge. He places the can convenient to the breech and takes post about 2 feet to the rear and right of the breech, facing it. No. 2 procures a wiper or cotton waste and the sponge; he takes post about 2 feet to the rear and left of the breech, facing it.	No. 1 removes the breech cover and places it at the designated place. He examines the chamber, the bore, the breechblock and the breech mechanism, and cleans and oils them if necessary, assisted by Nos. 2 and 3. No. 2 removes the muzzle cover and places it at the designated place, prepares the lanyard (if used), examines, cleans, and oils the breech recess, assisted by No. 3.
Extractor detail, No. 3.	No. 3 procures the hand extractor and a pair of gloves. He takes post about 3 feet to rear of the breech, facing it.	No. 3 removes the filling plug. If the cylinder is not full he procures the measure containing hydroleneoil and the funnel, pours in oil until it stands in the filling hole, replaces the filling plug and the oil measure and funnel.

3-inch, 4-inch, or 4.7-inch gun drill.

At command **LOAD** or **COMMENCE FIRING**.	At command **CEASE FIRING**.
The gun commander gives the command **LOAD** or **COMMENCE FIRING** and supervises the work of his section.	The gun commander gives the command **CEASE FIRING** and supervises the work of unloading.
The gun pointer, having taken the travel of the target and set his sight for deflection, follows the target continuously, commands **CLAMP** (if clamps are provided) and fires or commands **FIRE** as soon after the command **READY** as the piece is pointed. If Case I is used he sets the sight for both range and deflection.	No duties.
The range setter keeps the piece laid continuously for range in accordance with the transmitted information, clamps the gun in elevation at the gun pointer's command and unclamps immediately after the gun is fired.	No duties.
No. 1 opens breech, closes it as soon as the cartridge is inserted, and commands **READY**. If there is difficulty in opening or closing the breech he wipes any residue from the threads of the breechblock and oils the mechanism. No. 2 picks up a cartridge and inserts it in the chamber, taking care that the point of the projectile does not strike. If there is difficulty in opening or closing breech he wipes any residue from the threads of the breech recess and oils the threads if they become dry.	No. 1 opens the breech and closes it after the cartridge has been removed. No. 2. No duties.
No. 3 receives the empty cartridge case as it is ejected and lays it aside. He uses the hand extractor when necessary.	No. 3 withdraws the cartridge.

NOTES ON THE DRILL.

198. All cartridges will be tried in the chamber before using. Those which do not fit accurately will be rejected.

199. If a cartridge jams, attempt will not be made to drive it home by forcing the block; it will be withdrawn and another substituted.

200. If a cartridge case is extracted with difficulty, the cause may be due to a burr around the edge of the chamber, and if one is found, it should be filed smooth.

201. With guns on masking parapet mounts, No. 3 procures the ratchet lever at the command **POSTS**, places it on the shaft, and at the command **RAISE GUN** mans the ratchet lever, assisted by the range setter, who clamps the pivot socket. The same numbers lower the gun when the drill is dismissed.

202. For 4.7-inch guns, battery commanders are authorized to modify the above drill to meet requirements.

Chapter XV.

GENERAL INSTRUCTIONS FOR SERVICE AT THE EMPLACEMENTS.

GENERAL INSTRUCTIONS.

203. The service of the piece will proceed with alertness and precision, and with as few orders as possible; aside from the necessary orders and instructions, no talking of any kind will be permitted. All movements of the cannoneers connected with the service of the piece will be made at a run.

204. The battery commander will train the gun commanders and gun pointers in giving commands, which will be quick and clear, but not louder than necessary.

205. Actual loading with dummy ammunition and pointing the gun as for service will be practiced at drills.

206. At the command **TAKE COVER**, given at any time, all cannoneers not designated to remain at their posts will move at a run to some designated place under cover. As a rule this command will be given in mortar batteries only.

207. A drill primer or a fired service primer will be used at drill.

208. The primer will be inserted after the breechblock is locked. The cannoneer who inserts the primer will be instructed to exercise the greatest care in lowering the leaf of the firing device. Under no circumstances will he insert or remove the primer by means of the button or wire.

209. Service friction primers are adjusted in manufacture to require a pull of about 25 pounds to start the wire to the rear, and about 40 to 45 pounds to pull the teeth through the compressed friction pellet and explode it.

210. The lanyard will be pulled from a position as near the rear of the gun as possible. A strong, quick pull (not a jerk) with as short a lanyard as practicable will be used.

211. Obturating primers are constructed so that when a primer is pulled and fails to fire, the primer wire is free to move forward without causing the composition to ignite. Extra precautions will be taken to prevent any attempt to use a primer that has failed.

212. Constant inspection of the safety pin on the firing leaf of the breech mechanisms in which combination primers are used will be made, since if the safety pin should be broken by harsh treatment and the pull upon the lanyard be upward by about 10° the primer probably would be ejected at the instant of firing and might injure the man firing the piece.

213. SIGNALS.—The commands or signals **ELEVATE, DEPRESS, RIGHT,** or **LEFT**, given in pointing, always refer to the direction of motion of the muzzle.

ELEVATE.—Raise either hand to the height of the head, fingers pointing upward.

DEPRESS.—Raise either hand to the height of the head, fingers pointing downward.

RIGHT or **LEFT.**—Motion with either hand, fingers pointing in the desired direction.

CLAMP.—Raise either hand with fist closed opposite neck, back of hand up, elbow bent and at height of shoulder.

HALT.—Raise and fully extend either arm vertically, hand and fingers open in prolongation of arm.

STAND FAST.—Raise and fully extend either arm horizontally straight to the front, hand and fingers open in prolongation of arm, back of hand up.

TAKE COVER.—Raise and extend fully both arms horizontally in prolongation of line of shoulders, hands open, fingers extended and joined, backs of hands up.

READY.—Raise either hand horizontally in front of forehead, fingers extended and joined, back of hand against forehead.

214. Signals with whistles or bugles are authorized.

CARE IN SEATING THE PROJECTILE AT GUN BATTERIES OF THE MAJOR ARMAMENT.

215. The shot truck carrying the projectile will be brought up to the face of the breech and the projectile pushed carefully off the truck until the base of the projectile is just inside the powder chamber. The truck will then be withdrawn and run off to one side. The entire ramming detail will then man the rammer as near its outer end as possible. At the command **HOME RAM** by the chief of breech, the ramming detail will rush the projectile forward hard into its seat, increasing the speed of the rush so that the projectile will have its fastest movement when it comes up hard in its seat.

216. Powder serving tray.—For guns of the major and the intermediate armament, there will be made wooden serving trays, each having sufficient dimensions to carry all the sections of one powder charge. The tray will be so shaped that the forward end will cover the screw threads in the breech, and it will be provided with cross handles to facilitate handling. Powder sections will be arranged in the same order they will have in the powder chamber.

217. As soon as the rammer has been withdrawn after seating the projectile, the nose of the powder serving tray will be inserted in the breech by the powder servers, and the rammer detail, in one motion, will push carefully the entire powder charge off the serving tray to such a distance that the breech block will give the powder charge a final push into the chamber in closing. The tray will then be removed and the breech closed. At least two trays will be provided for each gun.

BORE SIGHTING.

218. Guns will be bore sighted frequently in order to check the adjustment of the sight standard and to correct it if necessary. The process is as follows: Place a bore sight in the breech and a thread in the vertical diameter of the muzzle. Sight through the bore sight and bring the muzzle thread on a well-defined point of an object at or beyond the mean range for the piece. If a bore sight is not available, the vent or a thread in the vertical diameter of the breech may be used. Good results have been obtained by placing one of the objectives of a field glass against the vent when the breech is closed, a thread being in the vertical diameter of the muzzle. The effect is to cause the thread to appear like the vertical hair in a telescope, and the accuracy in sighting is practically the same as if a telescope were centered in the gun. With the sight in adjustment on the sight bracket and the vertical wire set at normal, the sight standard is adjusted until the vertical wire of the sight is brought on the point.

219. The azimuth indices of the guns of a battery will be set so that when the guns are aimed at a point near the main channel about midrange from the battery, the azimuth reading is the same for each; this will be the correct azimuth from the directing point or gun. In the event of there being two channels of equal importance a point at midrange and midway between the channels will be taken. By this means the azimuth differences due to gun displacement may be disregarded and in Case III the guns laid at the azimuth of the target from the directing point or gun.

220. In gun batteries of the major armament, range differences will be stenciled on the base ring or on the step of the loading platform, so that the proper correction for the gun displacement will be the number nearest an index marked on the carriage near the elevation scale.

ORIENTATION OF MORTARS.

221. The orientation of mortars will be tested frequently and the setting of the azimuth indices corrected, if necessary. Two convenient methods are as follows:

First. Having established two intervisible monuments in rear of the pits, and having determined accurately the azimuth of the line joining them, proceed as follows:

Set up a transit over a monument from which the pit may be seen; take a reading on the other monument and record it; take a reading on a point in the pit and record it. Move the transit to this point in the pit and back sight on the monument; record the reading.

Stretch strings across the vertical diameters of the breech and muzzle; point the mortar and the transit so that the axis of the mortar and line of collimation of the transit coincide; record the reading of the transit.

From the readings taken, the azimuth of the mortar may be computed and the index set.

The string across the breech may be omitted; in which case the axis of the mortar is fixed by the muzzle string and vent, the mortar being pointed at the transit when this is being done. It must be remembered in calculating the azimuth that the mortar is pointing in the opposite direction from the transit.

Second. By using the instrument in the battery commander's station in connection with the transit when they are intervisible, the transit being at any point on the parapet from which it can be sighted into the pit.

Adjust the transit. Set it up so that it can be sighted on the mortar and the battery commander's instrument; sight on the latter and record the reading. Sight the battery commander's instrument on the transit and record the reading. Point the mortar and transit so that the axis of the mortar coincides with the line of collimation of the transit and record the transit reading. From the readings, the mortar azimuth may be computed and the index set. The correct setting of the index will be indicated by a tool mark on the racer.

222. The adjustment of quadrants attached to mortars will be tested frequently, and corrected by using a clinometer or a standard quadrant known to be in adjustment.

METHODS OF POINTING.

223. Case I.—This method of pointing is used only with rapid-fire guns where means for laying in elevation by quadrant have not been provided.

Direction and elevation are given by the sight.

The gun pointer adjusts the sight in its seat and sets the elevation and deflection scales for the indicated range and deflection, respectively.

Case II.—This is the normal method of pointing all guns. Direction is given by the sight and elevation by an elevation or range scale attached to the carriage. For guns of the major armament the corrected range is taken from the time-range board. The gun pointer sets his sight to the deflection shown on the deflection recorder's board.

Case III.—This method of pointing is used exclusively for mortars. Its use for guns is auxiliary and is limited to batteries where the prevalence of fog or other local conditions render it necessary. Direction is given by the azimuth circle and elevation by the elevation scale or by quadrant.

In Case III guns are fired on the bell. Corrected azimuths for the first or second bell after the data are received are sent to the guns every 30 seconds. The gun pointer sets the azimuth for the bell on which it is desired to fire. The corrected range of the set-forward point for the same instant of firing is taken from the time-range board.

POINTING TESTS.

224. Pointing tests will be held frequently at gun batteries of the major armament in the following manner:

An assumed deflection for wind and drift is used during the test. This deflection is changed frequently during the drill so that gun pointers may not know the reading that should be obtained at the end of the time of flight. To accomplish this, the platen of the deflection board is set for the assumed deflection, and the setting is not changed as long as the same assumed deflection is used.

The gun pointer sets his sight at the deflection received from the plotting room, which is that obtained from the deflection board by combining the correction for angular travel during the time of flight with the assumed deflection for wind and drift. He gives the command **FIRE** as soon after the command **READY** as he is on the target; traversing is stopped and he then follows the target with the vertical wire. A noncommissioned officer equipped with a stop watch and a time-of-flight table starts the watch at the command **FIRE**; commands **HALT** and stops the watch at the expiration of the time of flight. The gun pointer stops following with the vertical wire at the command **HALT**, when the reading of the deflection scale should be the same as the assumed deflection for wind and drift. If not, the difference is the error in predicting and pointing.

Example: Assumed deflection, 3.65; deflection sent to gun pointer, 3.20; reading of the deflection scale at end of time of flight, 3.60. 3.65−3.60=0.05, the error.

For each trial records will be kept of the range to the target and the deflection error; and the gun pointer will be informed concerning the amount of his error.

225. The excellence of a gun pointer's work is determined, first, by the accuracy of his pointing; second, by the promptness with which he is able to give the command **FIRE** after the piece is ready.

226. With disappearing guns it is important that the gun pointer be trained to get on the target in the time necessary to close the breech plus the tripping interval, so that in practice or action no time will be lost in pointing the gun after it is in battery.

PREDICTION TESTS FOT MORTAR BATTERIES.

227. Prediction tests will be made frequently at mortar batteries in the following manner:

The battery commander is assisted by an officer or noncommissioned officer equipped with a stop watch and a time-of-flight table.

The azimuth of a predicted point and the corresponding time of flight is sent to the battery commander, who sets his instrument to the azimuth of the predicted point, the vertical wire at normal. As the target passes the vertical wire of his instrument, he commands **FIRE**, and follows the target by turning the disk crank. The assistant starts the stop watch at the command **FIRE** and calls "halt" at the expiration of the time of flight. The battery commander ceases tracking and the assistant records the reading of the instrument.

The difference between this reading and the azimuth of the set-forward point as determined from the plotting board is the error in prediction.

Example: Time of flight, 46⅗ seconds; azimuth of predicted point, 217.40°; azimuth of set-forward point, 214.49°; reading of the azimuth instrument, 214.59°; error in prediction, 0.10°.

Records of these tests will be kept and the results will be published to the battery command.

Chapter XVI.

TARGET PRACTICE—SALUTES.

228. Subcaliber and service target practice will be held in accordance with special regulations published annually by the War Department.

SUBCALIBER PRACTICE.

229. In subcaliber practice, in order to simulate the conditions of service practice, the gun pointer of a gun on a disappearing carriage will not be permitted to follow the target continuously. He will be required to cease traversing from the time the breechblock is opened until the charge is inserted, this being the time when, in actual loading, the truck is at the breech. After the charge has been inserted he will endeavor to get on the target in the time necessary to close the breech, plus the tripping interval. Subcaliber practice will simulate service practice as closely as possible.

SERVICE PRACTICE.

230. Before service practice, the battery commander will satisfy himself that all the material to be used at the practice is ready for service, special attention being paid to the following:

Adjustment of observing instruments.

Condition of communications.

Adjustment of plotting board and other equipment in the plotting room.

Adjustment of sights and sight standards at gun batteries.

Adjustment of azimuth indices at mortar batteries.

Adjustment of range scales of guns and quadrants of mortars, using clinometer.

Condition of recoil systems and setting of the throttling valves.

Condition of elevating and traversing mechanisms.

Adjustment of obturating devices.

Condition of shot trucks.

Weight and condition of projectiles.

Weight and condition of powder sections.

231. Prior to service practice, the bore, including the powder chamber of each piece to be used in practice, will be cleaned thoroughly and freed from grease and oil, the breechblocks will be dismantled and carefully examined.

232. All powder to be used for target practice at any battery will be stored in the service magazines of the battery at which it is to be used for at least two weeks before the trial shots are fired. After being stored in a magazine for two weeks, the temperature of the magazine may be taken as the temperature of the powder

without material error. The temperature of a magazine will be taken immediately upon opening the doors just prior to target practice.

233. Powder marked for one caliber or piece will not be used for any other caliber or piece of different chamber capacity.

234. In any case in which poor practice is believed to have been caused by defective powder, a special detailed report will be made to The Adjutant General through military channels.

235. Projectiles will be cleaned carefully before being inserted in the bore, lubricant will be removed, and the bourrelets will be freed of paint.

236. Immediately after a piece is fired, the breech will be opened and the primer will be removed.

237. Care will be taken to prevent injury to the gas check seat and to keep it clean. If any residue from the priming charge drops from the obturator into the gas check seat or the breech recess it will be wiped off.

238. When service ammunition is fired from guns (or mortars) above 4.7 inches in caliber, or when blank ammunition is fired from guns (or mortars) of any caliber, the powder chambers will be sponged and the mushroom head wiped off after each round and before loading for the next round, in order to insure the extinguishment of all sparks and the removal of smoldering fragments. The sponge and cloth used for this purpose will be dipped in hydrolene oil and the surplus oil will be removed from them before they are used.

239. Immediately after firing, the piece and accessories will be inspected by the battery commander and a report on their condition will be made by him (through the fire and fort commanders) to the coast defense commander. The bores of pieces will be washed clean with water, dried, and oiled. The breechblocks will be dismantled, and all parts cleaned and oiled.

240. When firing, officers and men will be advised to place the authorized ear protectors, cotton, or small pieces of waste in their ears, but they will not be permitted to place the finger tips in their ears.

241. Service practice will be preceded by careful instruction and will not be held by a company of coast artillery until such company is thoroughly familiar with the use of all of the equipment supplied for the service of the battery at which the company is to fire. No man will be detailed to a position at the practice unless he has been well instructed in the duties pertaining thereto.

242. In case of a misfire in artillery practice the primer will not be removed and a new one inserted for at least 10 minutes; during the interval, the piece will be laid on some portion of the field of fire where its discharge will not endanger shipping.

243. If firing by electricity, the circuit will be broken before the primer is removed. When using fixed ammunition and percussion primers, a second trial of the primer will be made if the firing device can be cocked by hand without opening the breech, but if this also fails, the breech will not be opened and a new cartridge substituted within 10 minutes. If it is found necessary to open the breech when using obturating primers, the vent will be

examined and cleared if necessary and the rear section of the powder charge will be pulled a little to the rear, so that the mushroom head will push it to its place; the breech will be closed and another primer will be tried.

244. At the command **CEASE FIRING**, lanyards will be detached. If using electric primers, the circuit will be broken. With rapid-fire guns using metallic cartridge cases, the breech will be opened. If firing is not to be resumed, fixed ammunition and separate powder charges will be withdrawn. Projectiles not loaded and fused will be driven back and withdrawn. Separate projectiles loaded and fused will be left in the gun until a favorable time to fire them; on no account will an attempt be made to drive them back.

245. Whenever a junior commander is ordered to fire under circumstances which from his position he judges to be unsafe, he will hold the fire until he can report the condition to the next higher commander.

SALUTES.

246. Salutes with cannon will be fired under the charge of a commissioned officer. The interval between shots will be five seconds. Only guns using metallic cartridge cases will be employed in firing salutes.

247. In firing salutes, the powder chamber of the gun will be sponged and the mushroom head wiped off after each round to extinguish all sparks and to remove residue. The sponge and cloth used for this purpose will be dipped in hydrolene oil and the surplus oil will be removed before using. Worn sponges or those that do not fill the chamber of the gun will not be used.

248. Salutes will not be fired unless the above conditions can be fulfilled.

Chapter XVII.

FIRE AND MINE COMMANDS.

THE FIRE COMMAND.

249. Manning parties for a fire commander's primary and secondary stations.

Primary station:
- Fire commander.
- Communication officer.
- Electrician sergeant.
- Observer.
- Reader.
- Operator for each telephone.
- Operator for each searchlight controller.
- Plotter, assistant plotter, and two arm setters, when plotting board is used.
- Orderlies.

Secondary station:
- Observer.
- Reader.

250. Fire commanders will be assigned to fire commands by orders from coast defense headquarters.

251. The fire commander is responsible for the drill and the tactical efficiency of his fire command.

252. His duties will be confined to those affecting the tactical efficiency of his command.

253. Normally, he controls his command from the fire commander's station, but when necessary may go wherever his presence is required.

254. He will be responsible that the fort commander is informed as to any deficiency of equipment or supplies.

255. If a field officer, on days of battery drill, he will visit the batteries of his command, and on days of indoor instruction, the companies of his command during the instruction period.

256. He will require a thorough knowledge of the installation, equipment, system of fire control, and drill on the part of the officers of his command, will encourage efforts for the improvement thereof, and will require the system of commands prescribed herein to be used.

257. The fire commander will have the assistance of a staff officer, who will be called the communication officer. The communication officer will have charge of the system of communications and of the fire commander's manning party. In case an officer is not available, a noncommissioned officer (preferably a sergeant major) will be so assigned.

258. The communication officer will inspect the equipment of the station, will receive the reports of the chiefs of detail, and will report to the fire commander: "Sir, F′ (or F″) in order," or will report defects he is unable to remedy without delay.

259. Each member of the manning party on reaching his station will examine the apparatus to which he is assigned, will make the prescribed tests and adjustments, and will report to his chief of detail. On completion of the examination, each chief of detail at the primary (and secondary) station will report to the communication officer: "Sir, F′ (or F″) in order," or will report defects he is unable to remedy without delay.

260. The fire commander will indicate a target to his observers as follows: 1. Target. 2. Name of one of the subareas into which the battle area is divided by the coast defense commander ———. 3. Name (or type and class) of an isolated ship, or designation of division, formation, ship number ———, or in "number of covering illuminating light." If, in the judgment of the fire commander, a target can not be sufficiently indicated to the battery commander by description, it may be tracked for two or three observations and its predicted position for a convenient interval ahead located. This predicted position is relocated for the battery by means of the pantograph attachment of the F′ plotting board, when provided, and the relocated range and azimuth sent to the battery commander's station. The fire commander's instrument is set to the predicted azimuth and "now" called over the telephone as the target crosses the vertical wire.

261. The fire commander will control the searchlights assigned by the fort commander as illuminating lights for his fire area.

262. When ordered by the fort commander to assume the exercise of fire commander's action, or when for any reason the fort commander's station is not manned, or when communication therewith is interrupted, he will fight his command in accordance with the general plan of action. He will order "**BATTERY COMMANDER'S ACTION**" whenever the progress of the attack renders such action advisable, provided "**FIRE COMMANDER'S ACTION**" has been previously ordered by the fort commander or when emergency renders it necessary.

263. In exercising fire control, the fire commander will determine the order of fire for his batteries.

264. In giving commands to his batteries, the fire commander will proceed as follows:

First. **ALL BATTERIES** (or name of any battery or batteries, as **EUSTIS**, or **EUSTIS** and **CHURCH**), **TARGET**, will signify that a target is to be assigned and will have the effect of calling the particular battery or batteries to attention.

Second. The name of one of the subareas into which the battle area is divided by the coast defense commander. When the subarea is designated, all observers concerned will turn their instruments in the general direction of the target. At night, in addition to the subarea, the number of the searchlight which is covering the target will be given.

Third. Designation of target. That is, name (or type and class) of an isolated ship; or designation of division, formation, ship number ——.

NOTE.—Ships in line are numbered from the starboard ship. Ships in column are numbered from the leading ship.

Fourth. The order of fire desired.
COMMENCE FIRING.
FIRE WHEN IN RANGE.
FIRE WHEN AT ——— YARDS.
FIRE ——— ROUNDS, COMMENCE FIRING.
FIRE AT ——— INTERVALS, COMMENCE FIRING.
FIRE ON SALVO POINT NO. ———.
FIRE AT SHIPS IN ORDER IN COLUMN, COMMENCE FIRING. (This requires fire to be opened on the leading ship, continuing until disabled, or until the fire commander commands ——— **TARGET OUT OF ACTION**, then changing to the next ship in column.)
FIRE AT SHIPS IN ORDER IN LINE, COMMENCE FIRING. (This requires fire to be opened on the starboard ship of the line, continuing until disabled, or until the fire commander commands ——— **TARGET OUT OF ACTION**, then changing to the next ship in line.)

265. The following commands are given as examples: (Dashes indicate pauses.)

1. **ANDERSON** ———. **TARGET** ———. 2. **BUCKROE** ———. 3. **TEXAS** ———. **COMING IN** ———. 4. **FIRE WHEN IN RANGE.**

1. **WHEELER** ———. **TARGET** ———. 2. **BOCA CHICA** ———. 3. **OIL TANK** ———. **CLASS 1-3. GOING OUT** ———. 4. **FIRE TWO ROUNDS** ———. **COMMENCE FIRING.**

1. **PARKE** ———. **TARGET** ———. 2. **TABOGUILLA** ———. 3. **SUBMARINE DIVISION** ———. **SHIP NO. 3** ———. 4. **COMMENCE FIRING.**

1. **MERRITT** ———. **TARGET** ———. 2. **PANAMA** ———. 3. **BATTLE CRUISER DIVISION** ———. 4. **FIRE AT SHIPS IN ORDER IN COLUMN** ———. **COMMENCE FIRING.**

1. **MONTGOMERY** ———. **TARGET** ———. 2. **BUCKROE** ———. 3. **DESTROYER DIVISION, DOUBLE LINE** ———. **SECOND LINE** ———. **SHIP NO. 2** ———. 4. **FIRE WHEN AT 7,000 YARDS.**

266. A column formation can frequently be simulated at drill by a tug towing barges or targets. In such case, the barges or targets will be numbered from head to rear, thus:

1. **CHURCH** ———. **TARGET** ———. 2. **OCEAN VIEW** ———. 3. **COAL BARGE DIVISION GOING OUT** ———. **SHIP NO. 1** (the towing tug) **OR BARGE NO. 2** (second barge) ———.

1. **EUSTIS** ———. **TARGET** ———. 2. **LYNNHAVEN** ———. 3. **MILLS DIVISION** ———. **TARGET NO. 2** ———.

1. **PARROTT** ———. **TARGET** ———. 2. **HORSESHOE** ———. 3. **SAND DREDGE DIVISION** ———. **DREDGE NO. 1** ———.

267. No system of commands can cover all cases, but the form of commands prescribed herein will be considered as typical and will be followed as closely as practicable.

268. Other commands which may be given are as follows:

CEASE FIRING.—This requires firing to cease instantly.

CHANGE TARGET.—This requires firing to cease instantly, but requires all battery commands to be in readiness to identify a new target.

CLOSE STATIONS.—This indicates that all battery commands and the fire commander's manning party are to be dismissed. The senior chief of detail at each station will see that the instruments are secured and covered, that the switches controlling the electric circuits are left open, and that the windows are closed and fastened securely.

THE MINE COMMAND.

269. Manning parties for the mine commander's primary and secondary stations:

- Primary station—
  - Mine commander.
  - Assistant mine commander.
  - Observer.
  - Reader.
  - Searchlight operator.
  - Operator for each telephone.
  - Plotter and two arm setters.
  - Orderlies.
- Double primary station—
  - Double the above, except mine commander and orderly.
- Secondary station—
  - Observer.
  - Reader.
- Double secondary station—
  - Double the above.

270. The mine commander is in command of the elements of the mine defense. He is responsible for the drill, instruction, and tactical efficiency of his mine command, and bears the same relation to the fort commander as do the fire commanders, and his duties are similar to theirs.

271. His duties will be confined to those affecting the tactical efficiency of his command.

272. He takes station at the mine primary or at such other place as his duties may require.

273. He is responsible that the property officer requests for all material and apparatus necessary to carry out the approved scheme for submarine mining of his mine command, and that this material and apparatus is kept in proper condition for immediate service.

274. The mine commander, with the approval of the coast defense commander, will designate an officer of the mine command as mine property officer. The mine property officer will obtain from the artillery engineer all material and apparatus necessary for the mine defense. He will have direct charge of the store room, cable tanks, loading room, wharves, boats, boathouses, and mining casemates.

The personnel of the mine command are subject to the orders of the mine commander for service under the mine property officer for the care and preparation of any of this matériel.

275. The mine commander supervises and conducts the fire of the batteries of the mine command in the same manner and by similar commands as are used by fire commanders for the batteries of their fire commands.

Chapter XVIII.

THE FORT COMMAND.

276. Manning party for fort commander's station:

Fort commander.
Personnel officer.
Matériel officer.
Master electrician or electrician sergeant.
Observer.
Reader.
Operator for each telephone.
Operator for each searchlight controller.
Orderlies.

277. A fort command consists of all the means of seaward and landward defense, including personnel and matériel, located at any coast artillery fort.

278. The fort commander is responsible to the coast defense commander for all matters affecting the efficiency, instruction, discipline, and appearance of the personnel, and the service, care, and preservation of matériel of his command.

279. He coordinates the seaward and landward defense. Through the fire and mine commanders, he controls the seaward defense; through the support commander, he controls the landward defense.

280. When two or more fort commands cover the same water area, the seaward defense for that water area will be controlled by the senior fort commander of those fort commands which cover that area.

281. The tactical station of the fort commander will be designated by the coast defense commander with the approval of the War Department, and announced in orders from coast defense headquarters. Whenever, in the exercise of his duties, it becomes necessary for him to leave his station temporarily, he will turn over the direction of the seaward defense pertaining to his fort to the next senior coast artillery officer present for duty at the fort; if necessary, he will direct such officer to take station for that purpose at the fort commander's station.

282. He will require a thorough knowledge of the installation, equipment, system of fire control, and drill on the part of the officers of his command, will encourage efforts for the improvement thereof, and will require the system of commands prescribed herein to be used.

283. The fort commander will have two officers to assist him in the performance of his duties; these will be designated "Personnel officer" and "Matériel officer."

284. During drill, practice, and in action the personnel officer will have charge of all fire control communications of the fort command and will transmit the orders of the fort commander. In preparing for drill, practice, or action he will inspect all of the equipment of the fort commander's station, verify the adjustment of the position finder, and satisfy himself that the telephone system of the fort command is in good working order. He will report to the fort commander the fact that the station and communication system are in order, or will specify such defects as he may not have been able to remedy himself.

285. The matériel officer will have charge of the light and power service of the fort command and, during drill, practice, or action, of the manning parties assigned thereto. He will be responsible to the fort commander for the efficiency of the communication, light, and power service of the fort command.

286. All repairs, defects, or deficiencies pertaining to the armament and its accessories will be reported to the matériel officer, who will have them made, corrected, or supplied, if practicable, by means available at the fort; otherwise he will report them to the proper coast defense staff officer.

287. Prior to drill or action the matériel officer will satisfy himself by inspection or inquiry through the telephone service that the power and light system is in efficient condition. To this end, he will receive the reports of those in charge of the several power and light units, and when reports shall have been received he will report to the fort commander that the power and light systems are in order, or, in case any defects are reported that he is unable to remedy without delay, he will report such defects to the fort commander and will take steps to have them remedied at the earliest practicable time; if necessary, reporting them to the proper coast defense staff officer.

288. Each member of the fort commander's detail on reaching his station will examine the apparatus to which he is assigned, will make the prescribed tests and adjustments, and will report to the personnel officer, "Sir, ——— in order," or will report defects he is unable to remedy without delay.

289. The fort commander will indicate targets to his observer by commands similar to those provided for fire commands in Chapter XVII. He will study the battle area, and will consider the location and strength of the elements of the defense under his command, and will rehearse the forms of attack liable to be adopted by an enemy. While it is not practicable to anticipate all of the conditions of attack that may arise during an engagement, nor all of the methods of attack that may be employed by an adversary of initiative and resource, there are certain type forms which may be anticipated and which will be frequently rehearsed.

290. Before becoming committed to any form of defense he must understand the intentions of his opponents and consider the different courses of action open to the defense, with the advantages and disadvantages of each, and rapidly arrive at a clear and definite decision as to the best method of defense.

291. In giving his commands to his fire or mine commanders he will proceed as follows:

First. **ALL FIRE COMMANDS**, or F_1, (F_2, M_1, etc.), **TARGET**, will signify that a target is to be assigned, and will have the effect of calling the particular fire or mine commands to attention.

Second. The name of the subareas into which the battle area is divided. At night, in addition to the subarea, the type of ship and the number of the searchlight covering the target will be given as: **TARGET, PANAMA ——— BATTLESHIP ——— IN FIVE.** (Dashes indicate pauses.)

Third. Designation of target; that is, name (or type and class) of an isolated ship, or designation of division, formation, ship number ———. Usually the designation will be limited to a division or group of ships.

Fourth. The order of fire as,

COMMENCE FIRING.

FIRE (or **MINE**) **COMMANDER'S ACTION.** This command places the fire action in the hands of the fire or mine commander, but limits to the target or targets indicated.

FIRE WHEN IN RANGE.

FIRE WHEN AT ——— YARDS.

FIRE AT ——— INTERVALS, COMMENCE FIRING.

FIRE ON SALVO POINT NO. ———, COMMENCE FIRING.

FIRE AT SHIPS IN ORDER IN COLUMN, COMMENCE FIRING. This requires fire to be opened on the leading ship, continuing until disabled—then changing to the next ship in column.

FIRE AT SHIPS IN ORDER IN LINE, COMMENCE FIRING.

This requires fire to be opened on the starboard ship of the line, continuing until disabled—then changing to the next ship in line.

292. From time to time, on the occasion of fort command drills, the coast defense commander will prepare a general and special situation, which will be furnished to subordinate commanders, and as far as practicable with the limited number of vessels available as targets, the drill will represent some phase of an assumed attack.

METEOROLOGICAL STATION.

293. The station will be in charge of a meteorological observer, who, under the supervision of the personnel officer of the fort command, will be responsible for the station, the property therein, and the care, preservation, and adjustment of the instruments. He will be present in his station whenever the armament is served. As soon as he arrives at his station, he will adjust the mercurial barometer and test the aneroid, noting any correction to be made. He will connect the electrical device (if one is provided) of the anemometer, adjust the stop watch device if necessary, and note whether the wind vane works freely. He will report to the fort commander's station, "Meteorological station in order," or will report defects he is unable to remedy without delay.

294. He will read the barometer and thermometer. He will read the azimuth of the wind and determine its velocity by means of five readings of the anemometer. He will report to all fire commanders' stations the barometer and thermometer readings, and the velocity and azimuth of the wind.

295. The velocity and azimuth of the wind will be recorded at least every 20 minutes, and oftener if necessary; any sudden change, either in direction or velocity, of any considerable magnitude will be reported at once to the fire commanders. Any material changes in the barometer and thermometer readings will be reported to the fire commanders.

296. The meteorological observer will keep a complete record of all meteorological messages, which will be turned in to the fort commander at the end of each drill.

TIDE STATION.

297. The station, under the supervision of the personnel officer, will be in charge of the tide observer. He will be present in his station whenever the armament is served. He will be responsible for the station and the instruments therein. On arriving at his station he will report to the fort commander's station, "Tide station in order," or report defects he is unable to remedy without delay, and will telephone the state of the tide to the fire commanders. Thereafter he will report the tide for every change of one-half foot.

Chapter XIX.

THE COAST DEFENSE COMMAND.

298. A coast defense command consists of one or more forts with their accompanying mine fields and landward defenses.

299. Coast defense commands are established, their limits fixed, and their administrative headquarters designated in orders from the War Department.

300. The coast defense commander is both a tactical and an administrative officer.

301. There is no prescribed tactical station for the coast defense commander. At drill, and in action, he goes where his presence is necessary.

302. For convenience in indicating and identifying targets, he will divide the water areas into subareas and will give each subarea a name.

303. During actual or threatened action, either on the sea or land front, or both, the coast defense commander will coordinate and direct all military operations involving the coast artillery troops and the coast artillery supports. He will establish and maintain a system of security and information on the land and sea fronts of his command.

304. He will require of his officers a thorough knowledge of the installation, equipment, system of fire control and drill for fort, fire, mine, and battery commands, and will encourage a study of them, with a view to improvement therein.

305. Within the limits of his command, he will control all matters relating to all elements of his command.

306. When repairs are necessary to any part of the defenses, the armament or its accessories, such repairs will be reported to the proper coast defense staff officer. If these repairs are of a minor nature and are such that they can be made by means available and under the control of the coast defense commander, the staff officer (with the approval of the coast defense commander) will take the steps necessary to have them made. If the repairs are of such a nature as to require an allotment therefor from the funds appropriated annually for the maintenance of the defenses, the armament or its accessories, the coast defense commander will request the district engineer officer, the district armament officer, or the department signal officer, as the case may be, to make the repairs.

307. The operation of all means of water transportation assigned for the exclusive use of a coast defense command, including harbor vessels, tugs, lighters, dispatch boats, launches, and mine planters, during the period of their stay in the coast defense command, will be under the supervision of the coast defense commander, whose duty it will be to see that economy is exercised in their maintenance and operation. He will so combine the operations of these vessels as to limit them to the lowest number that can perform the service efficiently, bearing in mind that, when needed for artillery drill, vessels ordinarily engaged in the transportation of troops and supplies, or in other duty, should be withdrawn temporarily to provide an efficient drill and other coast artillery service.

308. Coast defense commanders will, once each month, make a thorough inspection of all artillery boats assigned to their commands. If the inspection develops that a boat is not kept in first-class condition, he will give the requisite orders regarding the care and cleaning of the boat. If the lack of care is on the part of the officer (or civilian master) assigned by higher authority to command of the boat, and is such as to render his relief advisable, recommendation will be made accordingly. If the officer is assigned by the coast defense commander, the necessary corrective measures will be taken by him.

309. Officers in charge of artillery boats will require the masters thereof to make careful daily inspections (Sundays and legal holidays excepted) of their boats. Masters will be held responsible for the condition of their boats and for the care and police thereof. In the case of mine planters, the officer assigned to command will make the daily inspection and will utilize the members of the coast artillery detachment aboard to assist in the care of the planter.

310. The distribution box boats will be assigned by coast defense commanders to mine commands, mine companies, or detachments assigned to mine defense for their care and use. The officer in command of the organization will be in charge of the boat or will designate an officer under his command for that duty. He will assign to each boat as crew two noncommissioned officers and one specially selected private; one noncommissioned officer to be master of the boat, one to be engineer, and the private to be deck hand.

311. To guard against accidents through ignorance in handling, and to enable the responsibility for accidents to be fixed upon the proper party, an officer responsible for an artillery boat will not permit it to leave its moorings unless in charge of its proper officers and crew. None of these boats will be used for purposes other than its regular duties, except by special permission of the fort commander of the fort to which the boat is assigned.

312. The coast defense commander will perform the duties prescribed for the post commander in paragraph 407, Army Regulations, 1913, with reference to vessels of war arriving in a harbor.

THE COAST DEFENSE ADJUTANT.

313. The duties of the coast defense adjutant are similar to those of regimental and post adjutants.

THE COAST DEFENSE ARTILLERY ENGINEER.

314. In the appointment of an artillery engineer, a graduate of the Coast Artillery School will, if practicable, be selected. The artillery engineer will be charged with the accountability of all engineer and signal property, stores, and installations that have been turned over to the coast artillery, and all mine property, stores, and installations in the coast defense command. He will inspect all property, stores, and installations for which he is responsible at each fort at least once each calendar month.

315. He will make requisitions for engineer, signal, and mine stores and for the necessary equipment for the approved installation required in the coast defense command. He will be responsible under the coast defense commander for their sufficiency and make all required returns to the chiefs of the respective supply departments.

316. He will issue engineer and signal property and stores to battery commanders, and mine property and stores to the mine property officer, obtaining memorandum receipts therefor.

317. He will recommend to the coast defense commander the transfer, when necessary, of available engineer, signal, and mine property from one fort to another. Within the limits of his command the coast defense commander is authorized to make such transfer unless the efficient operation of any approved installation will thereby be impaired. No apparatus or plant installed in any fortification, and no article or material belonging to such plant, the efficient operation of which will thereby be impaired, will be transferred without the approval of the Chief of Coast Artillery and of the chief of the supply department concerned. All transfers will be reported to the Chief of Coast Artillery and to the district engineer officer, the district armament officer, the department signal officer, or the disbursing officer of the Torpedo Depot, according to the nature of the article or articles transferred.

318. He will be charged with the repair, maintenance, and operation of lighting, central heating, ice, and pumping plants; and with the repair and maintenance of the systems of fire-control communication, all searchlights, power plants, and lines of power distribution.

319. He will prepare, quarterly, estimates for fuel, oil, and other materials supplied by the Quartermaster Corps for the operation of the plants in his charge, and submit the same to the quartermaster for his information in preparing his estimates.

320. He will render reports of the performance of each internal combustion engine issued by the Engineer Department, in accordance with the regulations of that department.

321. He will render such assistance in the test and maintenance of electrical equipment installed by the Ordnance Department on seacoast armament as may be requested by the ordnance officer.

322. Normally, the master electricians, engineers, electrician sergeants, firemen, and master gunners at any fort perform their duties under the direct supervision of the fort matériel officer. When necessary, the artillery engineer, with the approval of the coast defense commander, may utilize any of the enlisted specialists in any part of the coast defense command for keeping all of the installed machinery, storage batteries, cable and pole lines, and other electrical and power apparatus in serviceable condition.

323. Except in case of emergency, enlisted specialists will not be employed solely as clerks or storekeepers, and when necessary to employ them as such it will be reported to the ArtilleryDistrict commander and the time spent in the performance of those duties will be reduced to the minimum.

324. Coast defense commanders, in detailing enlisted men to assist the artillery engineer, will endeavor to develop suitable candidates for appointment as enlisted specialists.

325. When power plants require repairs which can not be made by the facilities available to the artillery engineer, but which can be made with the assistance of the resident ordnance machinist and by the use of material from the ordnance repair shop, the artillery engineer will request the ordnance officer to make such repairs, and the latter is authorized to do so, provided that the work on the armament is not interfered with and that the work is done in accordance with the regulations of the respective staff departments concerned.

326. All submarine mine cable stored in a coast defense command will be tested annually, and the record of the test will be entered in the cable book supplied from the Torpedo Depot for the purpose. The artillery engineer will be responsible that the test and record are made according to War Department orders and will be assisted by such personnel as may be assigned to that duty.

THE COAST DEFENSE ORDNANCE OFFICER.

327. The ordnance officer will be charged with the accountability for all ordnance property and ordnance stores pertaining to the armament and equipment in the coast defense command, and will inspect all such property and stores, for which he is responsible, at least once each month.

328. He will make timely requisition for ordnance stores and supplies for each fort separately, and will be responsible, under the coast defense commander, for their sufficiency. He will make such returns and reports in regard to the ordnance property as may be required by the Chief of Ordnance.

329. He will issue on memorandum receipts to the proper officers, all ordnance property and supplies pertaining to the armament. He will recommend to the coast defense commander the transfer of available ordnance property and stores from one fort to another within the coast defense command. The coast defense commander is authorized to make such transfers, but the transfer of guns, carriages, and range finders, or other matériel permanently emplaced, will not be made without authority from the Secretary of War.

330. He will have charge of the ordnance repair shops, supervision over resident and other machinists of the Ordnance Department, and general supervision over all authorized repairs to the property for which he is accountable.

331. He will call upon the artillery engineer for such technical assistance as may be necessary for the test and maintenance of electrical equipment under his charge.

COAST DEFENSE QUARTERMASTER.

332. In addition to his duties as quartermaster of the coast defense command, which are analogous to those of a post quartermaster, he will be accountable and responsible for all water transportation assigned by competent authority for the exclusive use of the coast defense command, including harbor vessels, tugs, lighters, dispatch boats, and launches. Under the coast defense commander, he is responsible for their condition, maintenance, and supply, for the discipline of their personnel, and for their efficient operation. Once each week he will make a careful inspection of each vessel for which he is responsible.

333. He may utilize, under rules of the Quartermaster Corps, the ordnance repair shop in the same manner as is herein authorized for the artillery engineer.

INSPECTIONS BY OFFICERS OF THE ENGINEER CORPS, THE SIGNAL CORPS, THE QUARTERMASTER CORPS, OR THE ORDNANCE DEPARTMENT.

334. When any officer of the Engineer Corps, the Signal Corps, the Quartermaster Corps, or the Ordnance Department who is authorized to make inspections of the matériel of the coast defense command gives notice of the time of his inspection, the coast defense commander (or the fort commander) and the coast defense staff officer concerned will accompany the inspector if practicable. The coast defense commander will take prompt remedial measures with respect to all defects reported by an inspecting officer which can be corrected with the facilities at his disposal, reporting action taken by indorsement on the report of inspection in forwarding same to the coast artillery district commander.

Chapter XX.

COAST ARTILLERY INSPECTION.

335. The armament will be manned, instruments will be adjusted, and everything will be prepared for service.

336. The inspector will visit the stations and emplacements in such order as may be most convenient. During the inspection of a command he will be accompanied by its commander.

337. As the inspector approaches any station, the officer or noncommissioned officer in charge will call his command to attention, and will salute. The equipment will be inspected and operated as may be necessary to determine its working condition and the efficiency of the personnel.

338. As the inspector approaches a battery, he will be met and saluted by the battery commander, who will accompany him during the inspection of the battery.

339. When the inspector approaches a gun emplacement, the gun commander will command **ATTENTION, OPEN BREECH,** and will give such other commands as may be necessary for the execution of the inspector's instructions.

340. As the inspector enters the pit of a mortar battery, the pit commander will command **ATTENTION,** and as he approaches each piece, the chief of detachment will command **OPEN BREECH** and such other commands as may be necessary for the execution of the inspector's instructions.

341. An artillery inspection will be conducted so as to include the following:

(*a*) An examination of the equipments, the implements and all the parts of the guns, carriages, and emplacements, special attention being given to—

Obturators, to see if they are adjusted properly, and pads in serviceable condition.
Elevating and traversing mechanisms.
Devices for running in and from battery.
Recoil cylinders.
Throttling valves.
Oil holes and grease cups.
Adjustment of sights and means of giving quadrant elevation.
Adjustment of subscales of azimuth circles.
Firing attachments.
Firing batteries and circuits.
Motors and controllers.
Sponges.
Rammers.
Condition of doors.
Condition of drains and diagrams of same posted.

Condition of hoists.
Condition of electric and other lights.
Condition of electric installation and power plants.
Condition of galleries and magazines.
Condition of emplacements and grounds in their vicinity.

NOTE.—All doors should be opened and closed. In preparing guns, mortars, and their carriages for inspection a thin coating of lubricant will be left on bearing surfaces.

(*b*) Examination of fire-control stations and apparatus, special attention being given to the condition and adjustment of all instruments and appliances, tables, and charts, and to the knowledge observers and operators have of adjustments and operation of instruments, appliances, tables, and charts.

NOTE.—Power plants, lights in magazines, and range transmission apparatus on loading platforms and on carriages should be in operation during the inspection.

(*c*) Simulated target practice including simulated fire with dummy ammunition at a moving target.

(*d*) Examination of mining casemate, storeroom, loading room, wharves, boathouses, cable tanks, and mine-planting boats, special attention being given to—

Operating boards.
Engines.
Motors and generators.
Storage batteries.
Sleeping rooms.
General condition of buildings.
Painting of the mine cases.
Piling of the mine cases.
Lubrication of screw threads on all apparatus.
Condition of anchors, distribution boxes, mooring ropes, and raising ropes.
Condition of small tools and supplies.
Condition of cranes, tram cars, and trucks.
Storage of the cable and security of all ends above the water.
Examination of cable-testing records.

And for boats—

General condition.
Condition of engines.
Condition of hoisting apparatus.
Condition of davits and blocks.
Condition of cable-laying apparatus.
Condition of small tools.
Condition of men's quarters.
Knowledge and expertness of personnel.

(*e*) An examination of the uniform of the personnel.

(*f*) An examination of emplacement and fort record books.

Chapter XXI.

SEARCHLIGHTS—NIGHT DRILL.

TACTICAL USE OF SEARCHLIGHTS.

342. Searchlights are one of the most important elements of the defense in a coast defense command. Upon their efficiency and correct tactical use will depend largely the successful defense against any naval attack at night.

343. The standard service searchlights are 60-inch, but there are some 24-inch, 30-inch, and 36-inch searchlights still in service.

344. Depending upon their tactical use, searchlights are classified as searching or as illuminating lights, and, depending upon their assignment (temporary or permanent), searchlights are classified as fort, fire, or mine searchlights.

345. The officer controlling the seaward defense of any water area (par. 280) will also control all searchlights covering that area, and will order the various searchlights in action and out of action. He may at any time turn over the control of any searchlight to a junior commander.

346. For the purpose of controlling the searchlights by command, the searchlight area will be divided into subareas, each designated by a suitable name, which, if practicable, will be the same as the subareas into which the battle area is divided by the coast defense commander. (Par. 302.)

347. The fort commander's searchlights may be used by the senior fort commander to search various subareas of the battle area in accordance with the special conditions prevailing at the time.

348. The senior fort commander may assign fire or mine searchlights to search specified subareas, or he may assign certain subareas to be watched by various commanders who, with or without the aid of an assigned searchlight, may discover hostile vessels.

349. Illuminating lights are intended primarily to illuminate targets assigned to fire or mine commands, and when used for this purpose may be controlled by the fire or mine commanders.

350. An illuminating light may be used for searching in two ways: First, the fire commander may be directed to search a designated subarea, in which case the searching is done under his orders; second, the fort commander through the matériel officer may direct the searching by telephone, in which case the operator acts under the orders of the matériel officer of the fort command.

351. A mine light is ordinarily under the control of the mine commander and is used by him for searching the mine field and illuminating targets therein, but may be used by the senior fort commander for other purposes.

352. When a vessel is discovered by a searching light and the senior fort commander decides to open fire with a fire command, he directs that the vessel be covered by another searchlight, which then becomes the illuminating light for that fire command. When covered by the illuminating light, the searching light may uncover and remain at the disposition of the officer controlling the seaward defense.

353. MANNING PARTIES FOR SEARCHLIGHTS.

When operated from a central plant:

Controller operator.	At the fort (fire or mine) commander's station.
Operator Assistant Watcher Telephone operator	At the searchlight.

When operated by a local internal combustion engine:

Controller operator.	At fort (fire or mine) commander's station.
Engineer Operator Assistant Watcher Telephone operator	At the searchlight or the searchlight plant.

When operated by a local steam plant:

Controller operator.	At fort (fire or mine) commander's station.
Engineer Fireman Operator Assistant Watcher Telephone operator	At the searchlight or the searchlight plant.

354. The matériel officer will take station in the fort commander's station, and in addition to his other duties will be responsible for the instruction and drill of the searchlight manning parties.

355. The watchers should be men of intelligence, with normal vision (20/20) without the use of corrective lenses, free from color blindness. They will be instructed in the hydrography of the harbor, methods of identification, and characteristics of the various classes of naval vessels and of local shipping. They will be equipped with a pair of field glasses and a head set bridged on the searchlight line and stationed on the outside of their searchlight at such a distance (about 100 yards) as to detect readily any vessel passing into the beam. Any vessels (or targets) detected will be reported by telephone to the fort (fire or mine) commander's station.

356. A searchlight operator should be a man of intelligence, interested in his work, and appreciating its importance, preferably one who has had experience in the use of electrical and mechanical apparatus. Unless necessary, operators will not be changed from searchlight to searchlight, as no two searchlights require precisely the same handling or adjustment.

SEARCHLIGHT COMMANDS.

357. The searchlights in a coast defense command will be designated by numbers, as 1, 2, 3, etc. (or by name).

IN ACTION signifies that a searchlight is to be put into operation. The command is given as follows: **TWO ——— IN ACTION.**

OUT signifies that a searchlight is to be put out of action. The command is given as follows: **ONE, OUT.**

SEARCH signifies that the searchlight is to search its entire area. The command is given as follows: **FOUR, SEARCH.** If the light is to search a certain subarea the command is **TWO, SEARCH LYNNHAVEN; THREE, SEARCH PANAMA;** etc. If a searchlight is searching a particular subarea and it is desired that it search the full area, the command is **THREE, SEARCH.** If the searchlight is covering a target the command is **FOUR, UNCOVER** and **SEARCH.**

358. When searching, a searchlight will be moved slowly back and forth through the designated area, and occasionally given an up-and-down motion. When a searching light has picked up a target in its area, unless otherwise ordered, it will keep that target illuminated to the limit of the area, and will then uncover and continue searching its area.

359. **FOLLOW** signifies that the searchlight is to follow a vessel even if the vessel passes out of the subarea which the searchlight has been ordered to search, as **TWO, FOLLOW.**

——— **COVER** signifies that a designated searchlight is to cover a target illuminated by some other searchlight. The command **TWO COVER THREE** signifies that searchlight 2 is to cover the target illuminated by 3. If 2 is on a target already, the command is **TWO UNCOVER AND COVER THREE;** the command **COVER** is preceded by **UNCOVER.**

——— **UNCOVER AND SEARCH** given to a searchlight covering a vessel indicates that that searchlight is to uncover and to search its entire area, no matter what the previous order may have been, as, **ONE, UNCOVER AND SEARCH.**

——— **AZIMUTH** ——— signifies that the designated searchlight is to be set at a given azimuth, as, **THREE, AZIMUTH 275.**

FOCUS, SPREAD, CONTRACT, RAISE, LOWER, RIGHT, LEFT, and **HALT** are commands to accomplish the object indicated by them.

If a small motion only is desired, when using the commands **RIGHT, LEFT, RAISE,** or **LOWER,** "**SLIGHTLY**" may be added; or the movement should continue until the command **HALT** is given.

At the command **ELEVATE,** the beam is raised 30 degrees and held there until further orders.

NIGHT DRILLS.

360. Special attention will be given to night drills in order to familiarize the personnel with their various duties under the conditions of night firing, and to insure the tactical efficiency of the lighting and power systems.

361. Battery night drill has for its object the instruction of the battery commands in the use of the equipment at night. For battery night drill, the tug will be sent out on the range and kept illuminated by a searchlight. The movements of the tug may be controlled by signals when necessary.

362. Coast defense, fort, or fire command night drills have for their object, instruction of the personnel in the correct tactical use of searchlights. For coast defense, fort, or fire command night drills, the tug will be sent out a sufficient time in advance to enable it to get beyond the maximum range of the searchlights before the drill begins. At the appointed time, it will turn and move according to instructions. All lights aboard except those necessary to comply with the laws of navigation will be kept extinguished during the drill. The fire control personnel will attend; the remainder of the personnel except the range sections, gun pointers, and traversing details (of gun batteries) may be excused.

363. Searchlights will not be thrown on any vessels except those provided by the Government for coast artillery purposes. If by accident a searchlight beam is thrown on any other vessel, it will be removed as soon as the mistake is discovered.

364. Searchlight-control drill provides the coast defense commander with an occasion to test the efficiency of the searchlights, and the readiness with which they respond to his orders. To this end, he will board one of the coast artillery boats and steam over the battle area. By signal to the fort commanders, he will give orders; for placing various searchlights in or out of action; for focusing, contracting, spreading, concentrating, or dispersing beams, and for testing the facility with which searchlights pick up targets, noting the extreme range under varying atmospheric conditions that this can be done.

Chapter XXII.

MEANS OF COMMUNICATION.

365. The means employed for the transmission of orders and information in the coast artillery service are as follows:

Radio telegraphy for communication between coast defense headquarters and other radio stations, and boats equipped with radio sets.

The telephone for communication between the units of the tactical chain of command and for the transmission of data.

The electrical or the mechanical transmission device as an auxiliary means of transmitting data from plotting rooms to emplacements or pits.

Speaking tubes for communication between the battle commander's observing room and the telephone booths of his station, between fire commanders' stations and near-by battery commanders' stations, between emergency stations and plotting rooms and as an auxiliary means of communication between plotting rooms and emplacements or powder magazines.

Flags, heliographs, and other means of signaling for communication between forts and between forts and boats when radiotelegraphy or other means of communication are not installed.

SIGNAL STATIONS.

366. Signal stations are established at such coast artillery forts as may be prescribed in War Department orders. These stations are equipped with telephones to the fort switchboard, and such other equipment, including radio outfits, as may be prescribed in War Department orders. The stations are in charge of the operators necessary for their proper service, and are under the supervision of the artillery engineer.

THE TELEPHONE.

SELECTION OF OPERATORS.

367. In selecting operators, the following methods of testing will be used, and, except in an emergency, no man will be assigned as a telephone operator unless he has been found proficient in these tests.

368. Enunciate distinctly through the telephone, letters which sound somewhat alike, as B, C, P, T, E, and ascertain whether they can be distinguished readily; enunciate a number of words beginning with S, such as seven, six, sight, sound; try such words as four, more, score, door, bore.

369. After a test of this kind with an instrument in good order, try with an instrument which is not working well.

370. After the hearing test, give a number of selected words to be sent through the telephone to test the operator's ability to enunciate distinctly.

371. Other qualifications being equal, men should be selected who are in the habit of speaking slowly and distinctly. A man who raises the pitch of his voice when excited should not be selected.

372. Operators should have a sufficient knowledge of their instruments to correct minor defects, such as loose or corroded contacts, or bent levers.

TEST OF TELEPHONES.

373. Upon arriving at his telephone, each operator will test his instrument by raising and lowering the hook switch. If this operation results in a sharp click in the receiver, the battery is in working order. If no click is heard, the binding post to which the head sets are connected should be examined and tightened and the test repeated. If there is no power on the line, the operator will report to his chief of station.

374. The principal operator on each line will call up all other operators on the line and will send and receive messages of sufficient length to indicate that the system is in order. He will report the result of his test to the chief of his station.

375. Telephones will ordinarily be repaired by an electrician sergeant or his assistant. Detailed description of the service telephones and information in regard to locating telephone faults can be found in Signal Corps Manual No. 8.

376. The principal troubles occurring in the service may be traced to the following causes:

(*a*) No power on line.
(*b*) Broken cords.
(*c*) Poor hook-switch contacts.
(*d*) Heating of transmitters.
(*e*) Poor magneto contacts.
(*f*) Pierced condensers.

(*a*) "No power" may be indicated by no tap of bell or click in receiver when hook is raised, by not receiving shock upon touching line terminals with moistened fingers, or by easy turning of magneto when condenser is short circuited. No power at telephone may be due to open circuit or short circuit on the line.

(*b*) (*c*) Broken cords and poor hook-switch contacts usually produce irregular operation, because the circuits may be complete one instant but will be broken by the slightest jar or movement of the cord.

(*d*) When hook switches are left up for an hour or more at a time, the carbon grains in the transmitters heat, lose their resiliency, and pack, and the transmission becomes poor and may finally cease altogether. Whenever it is necessary for the stations to be manned for long periods of time, the hooks should be kept down as much as possible. A transmitter never regains its original efficiency after having once become packed.

(*e*) Poor magneto contacts manifest themselves by easy turning of magneto and failure of the bells to ring.

(*f*) When a condenser becomes pierced the transmission is not impaired seriously, but the magneto turns very hard and irregularly, due to direct current through its armature. The storage battery discharges continuously through the bell, causing it to operate uncertainly.

USE OF TELEPHONES.

377. In sending messages the following rules should be observed:

1. Speak into the transmitter holding the head in a natural position, the lips about an inch from the transmitter.

2. Use a moderate tone of voice and speak slowly and distinctly, being careful not to slur the words or syllables, but to enunciate clearly each sound.

3. Never shout or raise the pitch of the voice.

4. Send numerals singly; thus, 4370 is sent *four, three, seven, zero*. Never use the letter O for zero. In sending an azimuth, or any number involving a decimal, the decimal point is called *point;* 246.34 is sent *two, four, six, point, three, four*. An exact hundred is sent as a hundred; thus, 200 is sent as *two hundred*, 4,500 is sent *forty-five hundred*. The same system applies to sending an exact thousand; 4,000 is sent *four thousand*.

5. If it is necessary to repeat, use more care as to distinctness, but do not raise the voice. A single number not understood may be accentuated by counting up to it and emphasizing it. Thus, if the figure four is not understood, say *four*—one, two, three, *four*.

6. Listen to the receiver repeat the message, and when any part of it is incorrectly repeated transmit again the part of the message which was not repeated correctly.

378. In receiving messages, the following rules should be observed:

1. Keep the mind on the message; a person can not receive correctly when he is thinking of something else.

2. Keep the receiver close to the ear.

3. Do not interrupt the sender unless absolutely necessary.

4. Repeat all messages received. When a part of a message is not understood, call **REPEAT**, and continue to have the message transmitted until it is understood.

CARE OF THE TELEPHONE.

379. Each operator will be required to keep his telephone in proper condition. The talking set should be hung in its proper place at the completion of drill, hook springs should be in place, the cords should be kept clear of possible interference, and a report should be made promptly of any defect in the telephone. The nickel plating should be kept polished with chamois; the connections external to the transmitters and receivers should be examined often for possible corrosion, and a strip of hard-surfaced paper drawn between platinum contacts to insure their cleanliness. Cords should be examined frequently for wear just behind the tips. Transmitter shells will not be opened by the operator under any circumstances.

Chapter XXIII.

APPARATUS USED IN FIRE CONTROL AND FIRE DIRECTION.

ANEMOMETER.

380. The anemometer consists of four hemispherical aluminum cups mounted on arms and a spindle so as to revolve under the action of the wind and to record its travel on a dial. In order to determine the wind velocity the anemometer is connected electrically in some cases with a device by means of which a stop watch is started or stopped whenever the anemometer closes an electrical circuit. The face of the stop watch is graduated to read the velocity of the wind in miles per hour. The first closing of the circuit starts the watch, the second stops it, and the third closing brings the hand back to zero. This operation is repeated continuously, a record of the velocity of the wind being obtained for every three closings of the circuit. There is ample time between the second and third closings to read the velocity of the wind. In case the electrical device is not provided, the watch may be started and stopped by hand, the proper instant being indicated by a bell or sounder. The record sent to the fire commanders' stations should be the mean of 10 readings.

ATMOSPHERE SLIDE RULE.

381. The atmosphere slide rule is a wooden slide rule, provided with two independent slides at opposite ends of the slide rule.

(*a*) The right-hand end of the slide rule is for the purpose of determining the correct reference number to be used on the range board for the density of the atmosphere when the thermometer and barometer readings are known. The slide carries the barometer scale on the upper edge and an index mark on the lower edge. The barometer scale is graduated from 28 to 31 inches of mercury. The upper arm carries the thermometer scale, which is graduated from −20 to 100° F. The lower arm carries the scale of atmosphere reference numbers, which is graduated from 0 to 32 with the normal at 16. If the correct barometer reading is set opposite the correct thermometer reading, the index on the lower edge of the slide will indicate the correct atmosphere reference number.

(*b*) The left-hand end of the slide rule is for the purpose of determining the velocity to be expected from powder at any temperature when the velocity obtained from the same lot of powder at any other temperature is known. The velocity scales are on the arms and are graduated from 2,000 to 2,400 foot-seconds on the upper arm and from 2,400 to 2,800 foot-seconds on the lower arm. The slide carries the powder temperature scale, which is graduated from 0 to 100° F. If the correct powder temperature used in a previous firing is set opposite the correct velocity obtained in that same firing, the velocity to be expected for any other powder temperature may be read on the same arm opposite powder temperature for which it is desired to determine the velocity.

AZIMUTH INSTRUMENT.

382. Figure 3 illustrates the Azimuth Instrument, model 1900. It may be mounted either upon a tripod, as in the figure, or upon a pier mount. It is used for measuring azimuths.

The instrument is said to be oriented when it is set up so that it will read azimuths. The operation is as follows:

First. Set the graduated circle and index to read the azimuth of a known datum point.

Second. With the azimuth clamp screw loosened, set the eyepiece slightly to the left of the reading window and clamp the azimuth clamp.

Third. Raise the whole instrument by grasping the top and turn it so that the telescope points in the general direction of the datum point with the plumb bob over the home station. In orienting the instrument on a pier mount, the instrument may be turned in the proper direction by loosening all of the leveling screws.

(Second and third are not essential to the reading of azimuths, but are provided so that when the adjustment is complete the parts of the instrument will be in the most convenient relative position for operation and reading.)

Fourth. Level the instrument. See that all the screws have a uniform and firm bearing on the leveling plate; set one of the levels exactly over two opposite leveling screws; turn the screws in opposite directions until the bubbles of each level are exactly in the middle, being careful to maintain a firm bearing of the screws on the plate. Turn the instrument through 180 degrees and correct one-half of any variation of either bubble by the adjusting screws on the level, the other half by the corresponding leveling screws. Repeat this operation until the bubbles remain in the middle of the tubes for any position of the telescope in azimuth.

Fifth. Focus the telescope (see Telescope).

Sixth. Bring the vertical wire of the telescope approximately on the datum point; tighten the azimuth clamp, and, using the azimuth slow-motion screw, bring the vertical wire exactly on the datum point. Clamp the slow motion.

The instrument is now ready to read azimuths. In using it, the vertical wire must be set accurately on the designated point of the object observed. In case of moving objects, it is essential also that this setting be made at the designated instant.

For a detailed description of the instrument, see Ordnance Pamphlet 1657. The 1910 model does not differ in principle from the 1900 model. Its description can be found in Ordnance Pamphlet 1656.

BAROMETER.

383. Both the mercurial and aneroid barometers are hung in the meteorological station. The aneroid barometer is always used for determining atmospheric data, the mercurial barometer being used to adjust the aneroid. To use the mercurial barometer for ordinary work involves too much loss of time.

DEFLECTION BOARD FOR GUNS. (MAJOR AND INTERMEDIATE ARMAMENT.)

(See Ordnance Pamphlet 1666.)

384. The deflection board is an adding machine by means of which the corrections for travel in azimuth during the observing interval, for travel in azimuth during the time of flight, and for wind and drift, are added algebraically. The total azimuth correction to be made on the gun arm, or the deflection to be set on the sight is indicated on the proper scale of the instrument.

The instrument consists of a base B, figure 4, upon which slides a movable frame A, called the platen; this frame slides on the rod C, to which it is attached by means of two lugs NN. In the left-hand lug there is a set screw M, by means of which the platen may be clamped to the rod C.

The rod C is attached to the base by the two brackets K and Q. In the bracket K is a threaded sleeve L, which can be turned by the milled head J, thus giving a slow motion to the rod and consequently to the platen.

Attached to the base at the lower side are three scales. Two of these, the deflection scale and travel scale, are fixed, and the azimuth correction scale is movable. (The travel scale is no longer needed in the use of the board.)

On the left-hand side and attached to the base is the wind arm F and the wind arc G.

Attached to the platen is the platen scale I, over which moves the travel arm D. The scale I can be given two positions on the platen, one corresponding to a time interval of 15 seconds and one to a time interval of 20 seconds. The multiplying scale on the circular part is for a 30-second observing interval, which is the only authorized observing interval.

Over all moves the T square E, which also slides on the rod C. On the face of the T square there is a range scale called the T square scale.

Attached to the left side of the platen is a piece of metal H, called the leaf. The curved edge of the leaf is a drift curve. On the left there is a range scale, which is used in setting the platen for wind and drift. This is called the leaf range scale.

Platen scale.—This is a scale representing travel in azimuth; it is graduated in degrees and hundredths, scale one-half of a degree to the inch. It is numbered from left to right, and the reference number at the origin is 15°, to correspond to the azimuth degree tally dial on the plotting board.

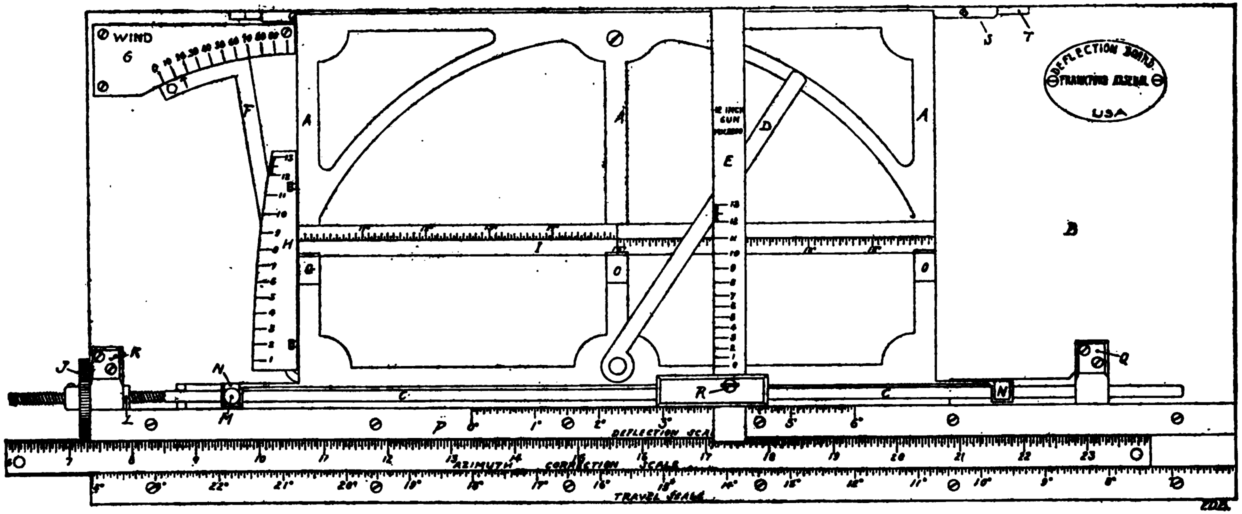

WIND
DEFLECTION BOARD
FRANKFORD ARSENAL
USA
12 INCH GUN
DEFLECTION SCALE
AZIMUTH CORRECTION SCALE
TRAVEL SCALE
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T

Fig. 4.

Deflection scale.—This scale indicates the deflection to be used on the sight in Case II, scale of half of a degree to the inch. It is numbered from left to right, with 3° in the center to correspond to the reference numbering on the sight scale.

Azimuth correction scale.—This scale indicates the correction to be applied to the gun arm on the plotting board in Case III. The scale is one-half of a degree to the inch, and it is numbered from left to right with 15° in the center to correspond to the numbering of the azimuth correction scale on the gun arm.

The wind arc.—The arc is graduated for wind components varying by 10 miles per hour. The origin (zero wind) is the graduation numbered 50, and the corresponding position of the wind arm is normal. The reference number zero corresponds to a left wind component of 50 miles per hour. The reference number 100 corresponds to a right wind component of 50 miles per hour. The wind arm is set to the proper reference number by the arrow index.

T square scale.—This scale, although graduated in yards of range, is a scale of times of flight. The range numbers are placed at a distance from the zero of the scale corresponding to the time of flight for the range. The time scale is 5 seconds to the inch. The origin of the time scale for the board is the center of motion of the travel arm.

The leaf range scale.—This is a nonequicrescent scale constructed so that the correction for wind and drift is applied by a single setting.

For subcaliber practice.—A special leaf scale and scale arm for the T square are used. When not supplied, paper scales should be constructed.

OPERATION.

First. Set the wind arm to the proper reference number, as indicated by the wind component board.

Second. Set the platen so that the point of the drift curve corresponding to the range will be accurately over the right-hand edge of the wind arm.

Third. Set the travel arm (right edge) for travel reference number as received from the plotting board.

Fourth. Set the azimuth correction scale so that the travel reference number is under the normal of the deflection scale.

Fifth. Set the T square so that the point of its scale corresponding to the range will be accurately over the right edge of the travel arm.

The bevel edge of the T square then indicates:

(*a*) On the deflection scale, the deflection to be used on the sight with Case I or II.

(*b*) On the azimuth correction scale, the correction to be applied to the gun arm when using Case III.

DEFLECTION BOARD FOR MORTARS.

(See Ordnance Pamphlet 1668.)

385. The mortar deflection board is illustrated in Figure 5. It consists of a cylinder A, on the elements of which are numbered, consecutively, azimuths from 1° to 21°, from 11° to 31°, etc., the last series running from 351° through 0° to 11°. The degrees only are on the cylinder, the azimuth subscale B giving the subdivisions to 0.05°. Any desired series may be brought into the slit on the shield R by turning the head K. Immediately below the subscale B is the drift scale C on the drift-scale slide D′, which is carried by the carriage D. The carriage is moved by turning the main traversing wheel E. There is a pointer H on the carriage for setting to any azimuth on the subscale. The carriage I may be moved by the head K independently of the carriage D. On the carriage I there are two pointers, the first, L, for setting the elevation on the drift scale C, the second, M, for indicating the corrected azimuth on the subscale B. The pointer M may be given an independent motion by the head N; the amount of this motion is indicated on the deflection scale P by the pointer Q.

The construction of the board depends upon the theory that the angular drift is constant for a given elevation whatever the velocity. Its operation is as follows: Set the pointer H to the plotting board azimuth of the set-forward point, bringing the proper degrees of the cylinder into view by means of the head X. Set the pointer L for the elevation as determined from the plotting board. If no arbitrary correction as a result of observation of fire is to be made, set the pointer Q to 3°, the normal of the deflection scale. The pointer M now indicates the azimuth of the set-forward point corrected for drift. Arbitrary corrections may be made at any time by setting Q to the proper reference number.

DEFLECTION BOARD FOR GUNS OF MINOR ARMAMENT.

386. The deflection board (fig. 6) provides a rapid, accurate means of obtaining the proper sight setting for rapid-fire guns and in emergency for large-caliber guns.

It consists of a rectangular piece of wood with two undercut grooves in it.

In the upper groove (*a*) there is a bar (*b*) which is graduated as shown in the cut (1″=1°).

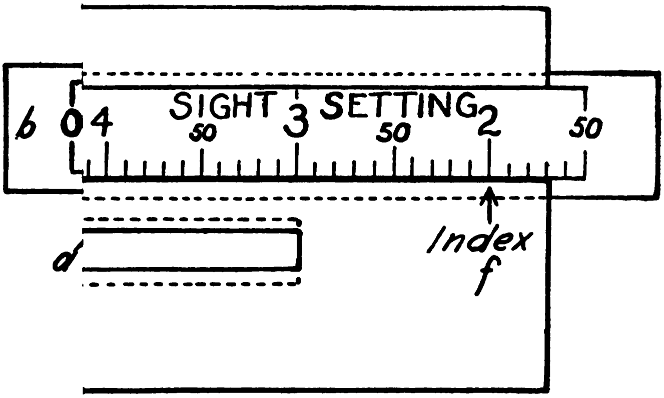
Different colored inks are used for the drift, travel, wind, and sight scales.

In the lower groove (*c*) there is a block (*d*) which carries a pointer (*e*). An index is placed on the board as shown at (*f*).

OPERATION.

Move the bar until the normal of the sight scale (3) is opposite the index (*f*).

From the authorized range table get the drift for the range.


b
0
4
SIGHT
50
3
SETTING
50
2
50
Index
f
d

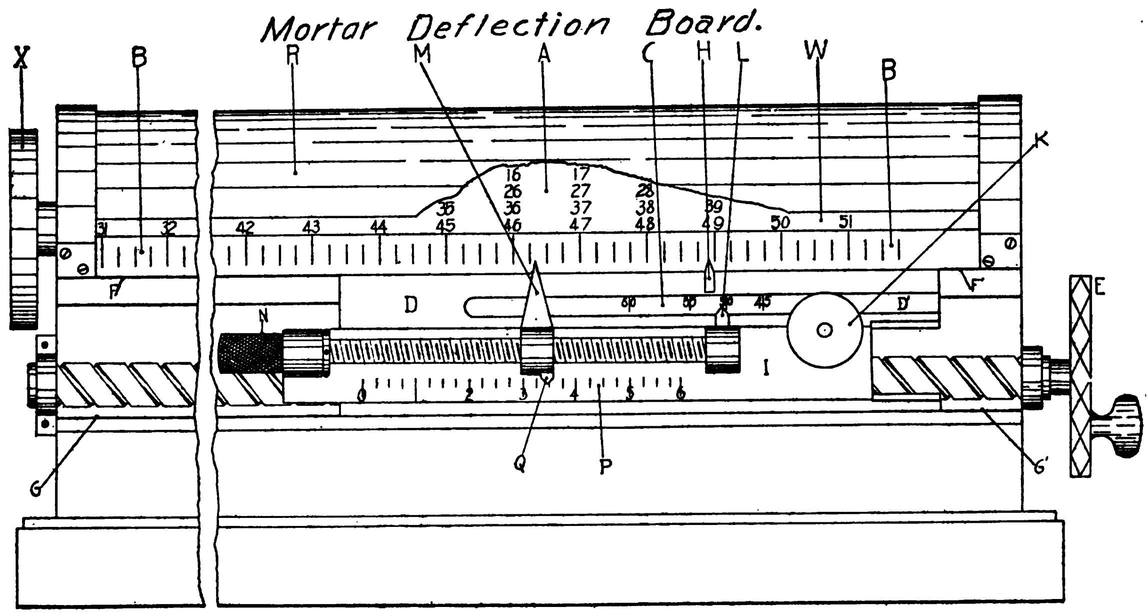

Mortar Deflection Board.
X
B
R
M
A
C
H
L
W
B
K
16 17
26 27 28
35 36 37 38 39
45 46 47 48 49 50 51
31 32 42 43 44
F
F'
D
D'
E
N
I
60 55 50 45
0 1 2 3 4 5 6
Q
P
G
G'

Fig. 5.

Set the pointer (*e*) to the zero of the drift scale; move the bar (*b*) until the drift, obtained from the range table, is opposite the pointer (*e*).

Set the pointer (*e*) to the normal of the travel scale; move the bar (*b*) until the travel reference number for the time of flight is opposite the pointer (*e*). This reference number is obtained by the gun pointer using the sight and following the target with the vertical wire during the time of flight.

Set the pointer (*e*) to the normal of the wind scale; move the bar (*b*) until the deviating effect of the wind (obtained from the range table) is opposite the pointer (*e*).

Read the sight scale over the index (*f*). This is the proper sight setting corrected for drift, travel, and wind.

DEFLECTION RECORDER'S BOARD.

387. The deflection recorder's board consists of a plain blackboard about two feet square. It is placed on the wall of the emplacement where it can be seen by the gun pointer. The deflection recorder wears a telephone head set in parallel with that of the range recorder.

The deflection recorder records the last deflection received when it differs from the last one recorded, erasing the latter. The record is written in large heavy numbers about eight inches high.

DEPRESSION POSITION FINDER.

388. Depression position finders are instruments for determining the position of an object by means of its azimuth and range. The azimuth features are similar to those described under the azimuth instrument. The range is determined by measuring the angle between the horizontal and the line from the instrument to the water line of the object, the measure of the angle being read directly from the instrument as the range. In addition to accurate setting of the vertical wire for azimuth, as in the case of azimuth instruments, the horizontal wire must be set accurately upon the water line of the object observed.

ADJUSTMENT OF THE SWASEY D. P. F.

(See Ordnance Pamphlet 1875.)

389.

1. Level the instrument carefully.
2. Telescope adjustments. (See Telescope.)
3. For reading azimuth angles, the instrument must be oriented by setting the azimuth of a known point on the scale and bringing the vertical wire exactly on the point by means of the azimuth adjusting screws. The holding down bolts for the base are situated so that the instrument is oriented approximately when the base is placed properly on the bolts.

4. The adjustment for reading ranges is made as follows:

(It is assumed that datum points at short, mid, and long range, D1, D2, and D3, have been established.)

(*a*) Set the height scale to indicate the height of trunnions of the instrument corrected for tide.

(*b*) Set the range drum to read the range of D3 and direct the telescope on that point; water line by means of the micrometer screw.

(*c*) Set the range drum to the range of D1, turn the telescope on it and water line by moving the top carriage along the height scale by means of the carriage knob.

(*d*) Repeat (*b*) and (*c*) until the adjustment permits approximately correct readings on D1 and D3.

(*e*) Then test on D2; should the difference between the range reading and the true range be small, no change in adjustment need be made. Should this difference be material, D2 should be substituted for D3 or D1 in (*b*) and (*c*) depending on the range at which the instrument is to be used (for D1, if a longer, and for D3, if a shorter, range than D2).

This adjustment once made should be checked from time to time.

Where no datum points have been established, the method of adjustment is similar to that given above by making use of buoys or other fixed objects that can be water lined and the ranges to which have been determined previously by the horizontal base system. As far as practicable they should be at long, mid, and short ranges, corresponding to D1, D2, and D3, above.

If reference marks have been established on one or more datum points, set the height scale for the height of the trunnions of the instrument above the reference mark, and, with the range drum set to read the correct range, make the horizontal wire coincide with the reference mark by means of the micrometer. Set the height scale index to indicate height of the trunnions of the instrument corrected for tide and proceed as in (*b*), (*c*), and (*d*) above, or, if the tide is not known, water line as in (*c*) and repeat (*b*), (*c*), and (*d*) as before.

ADJUSTMENT OF THE LEWIS D. P. F., MODEL 1907.

(See Ordnance Pamphlet 1876.)

390. The Lewis D. P. F., model 1907, consists of a pedestal on which are mounted two trains of gears which operate, respectively, the range and azimuth scales. The inclination of the telescope is given by means of a double row, which insures constant parallelism of the graduated arm on which the height scale is laid off and which transmits the motion of the screws directly to the telescope. The index slide on the height scale carries a refraction screw.

To correct automatically for a variation in height, a cam attachment operates a slotted bar which is connected with the refraction screw.

Rapid changes in azimuth are made by turning the upper plate of the instrument, the friction of the gear not offering enough resistance to prevent this; slow changes in azimuth are made by turning the azimuth head.

This instrument has three leveling screws. To level it: set one of the levels over two of the screws and turn the screws in opposite directions until the bubble is in the middle. Bring the bubble of the other level to the middle by means of the third leveling screw alone. Turn through 180° and correct, as prescribed for azimuth instrument.

When the instrument is leveled but one adjustment for range reading is necessary. This is made as follows: Set the height scale to correspond to the height of the trunnions of the instrument corrected for tide. Set the range scale to the range of a datum point, preferably one at mid-range. Water line the datum point by means of the refraction screw.

For reading azimuth angles, the instrument must be oriented by setting the azimuth of a known point on the scale and bringing the vertical wire exactly on the point by means of the spanner wrench provided for turning the instrument on the pedestal.

For telescope adjustments, see Telescope.

PLOTTING BOARD FOR GUNS.

(See Ordnance Pamphlet 1669.)

391. The plotting board is illustrated in figure 7.

The base-line arm may be moved through 1° either way and set to the proper reading by means of verniers attached to each end. The zero of the fixed scale of the vernier on the main azimuth circle opposite the vernier on the base-line arm may be assumed to correspond to any convenient degree number, depending upon the azimuth of the base line. It is convenient to consider the zero opposite one end of the base-line arm as corresponding to the nearest degree of the back azimuth (180°+the azimuth). For example, assume that the azimuth of the base line was 212.14°, and that the base line was left-handed. Then the zero of the scale opposite the left-hand end of the base-line arm would correspond to 12° and the zero of the scale opposite the right-hand end would correspond to 32°. To orient the base-line arm to correspond with the actual base, it is necessary to swing the base-line arm clockwise through 0.14°; that is, set the left end to 212.14°. The other would, of course, be set at 32.14°.

Assume that the azimuth of the base line was 212.80°, then the left end would correspond to 213° and the right end to 33°. To set the base line at 212.80° it would be necessary to swing the base-line arm counter-clockwise through 0.20°. In other words, the left-hand end is to be set at 212.80° and the right-hand end at 32.80°.

To prevent error, it is important that both verniers should be used, and both ends be set accurately.

The main azimuth circle and the gun azimuth circle of all boards issued are numbered at Frankford Arsenal in accordance with information furnished from the fort at which the board is to be used. This information includes a statement of the azimuth

of the normal to the base line of the position of the secondary station with relation to the primary and of the length of the base line.

Bring the gun-arm center over the primary center by placing the zeros of the longitudinal adjusting slide verniers and the lateral adjusting slide vernier coincident with the zeros of their respective scales. Be sure that the zero of the worm guard is opposite 15 on the azimuth correction scale, and the scale on the micrometer head of the worm is at zero. Bring the primary arm to the normal line of the board. Be sure that the pointer of the index box on the primary arm is at zero. Place the targ against the reading edge of the primary arm and bring the gun arm carefully against the targ. If done properly the reading edges of the primary and gun arms will coincide with the normal line. Set the azimuth pointer at the gun-arm azimuth window, by means of the adjusting screw, to the whole degree of the azimuth of the normal line. Next, set the gun-arm azimuth subdial indicator to zero by loosening the screw holding the indicator in place. This will allow of an adjustment of one-fourth, one-half, or three-fourths of a degree. If this is not sufficient, the tally subdial is removed. The inner dial face can be adjusted now within the limits of one-fourth of 1° by loosening the retaining screw and moving the dial until the pointer is at zero.

To verify this setting, the gun arm should be moved away from the targ and brought up to it several times. The gun-arm center is moved to the position on the board corresponding to the position of the gun by moving the adjusting slides the required distances in the proper directions, depending on the coordinates of the directing point, the primary station being taken as the origin.

Each board is given a serial number, stamped on the name plate and right-hand end of the azimuth circle.

For subcaliber practice.—To provide for reading shorter ranges than are shown on the gun arm, the graduations may be carried back to the inner end of the arm by the use of a paper scale pasted on the side of the arm, or the normal of the range correction scale of the gun arm and the ruler of the range board may be taken as 2,400, and a paper scale pasted on the gun arm showing ranges from 1,400 to 3,500 yards.

PLOTTING BOARD FOR FIRE COMMANDERS.

(See Ordnance Pamphlet 1670.)

392. The plotting board for fire commanders is similar to the plotting board for guns, but has in addition a pantograph attachment and a reverse plot of the location of the batteries and stations. The gun center is mounted on ball-bearing lateral and longitudinal slides. It may be set over any desired point by means of the pantograph, the stylus attached to one of the arms of the pantograph being set over the corresponding point on the reverse plot. The important points on the reverse plot such as the directing points of the batteries, position-finding stations, etc., are marked by small holes for the accurate setting of the stylus.

PLOTTING BOARD FOR MORTARS.

(See Ordnance Pamphlet 1669.)

393. The mortar-plotting board is the same as above described, except that a mortar arm provided with a sliding scale graduated in degrees and minutes of elevation and times of flight for each zone, and a gun center with a larger azimuth circle are substituted for the gun arm and gun center. The corrected elevation is read directly from the scale on the mortar arm.

The azimuth read from the mortar arm azimuth circle is corrected for drift by means of the mortar-deflection board.

For subcaliber practice at mortar batteries, the scale of the plotting board may be increased to 150 yards to the inch where local conditions permit. Unless subcaliber scales of 150 or 300 yards to the inch have been supplied, an elevation scale for attachment to the mortar arm conforming to the scale at which the board is to be used should be constructed at the fort.

RANGE BOARD FOR GUNS OF MAJOR AND INTERMEDIATE ARMAMENT.

394.

(See fig. 8.) **Description.**—The range correction board is a mechanical computing device used in determining the corrected range to be transmitted to the gun emplacements. It consists of a box, a chart frame, a range-correction chart, a marker system, a correction ruler, chains, sprockets, and counterweight.

The chart frame is secured within and fills the interior of the box. The range correction chart is pasted on, with its range scale perpendicular to the bottom edge of the chart frame.

The range correction chart is provided with four sets of correction curves, designated "atmosphere," "velocity," "tide," and "wind," a vertical range scale on each edge of the chart, horizontal range lines and data for accuracy tests. The curves are drawn to give the range correction for every 2 per cent variation in the density of the air, for every 10 foot-seconds M. V., for every 5 feet of tide, and for every 10-mile range component of wind. The red line on the chart is a line of no correction and is called the normal. To avoid liability of error, reference numbers are used, instead of two sets of numbers with the plus and minus signs. The horizontal scale of the chart is 200 yards to the inch.

The marker system consists of a bar on which slide markers are used to indicate the correction curve to be used in each set. The bar is attached to the box near its top.

The correction ruler consists of two range scales—one fixed, the other movable—both scales 400 yards to the inch; two bars—one fixed, the other movable—four movable pointers with clamps, one for each set of correction curves; a gear system for operating the movable parts; two fixed indexes and a movable index with reading glass.

The clamp for the pointers is so designed that each pointer is clamped independently of the others, either to the movable bar, to the fixed bar, or to both bars simultaneously. Any pointer

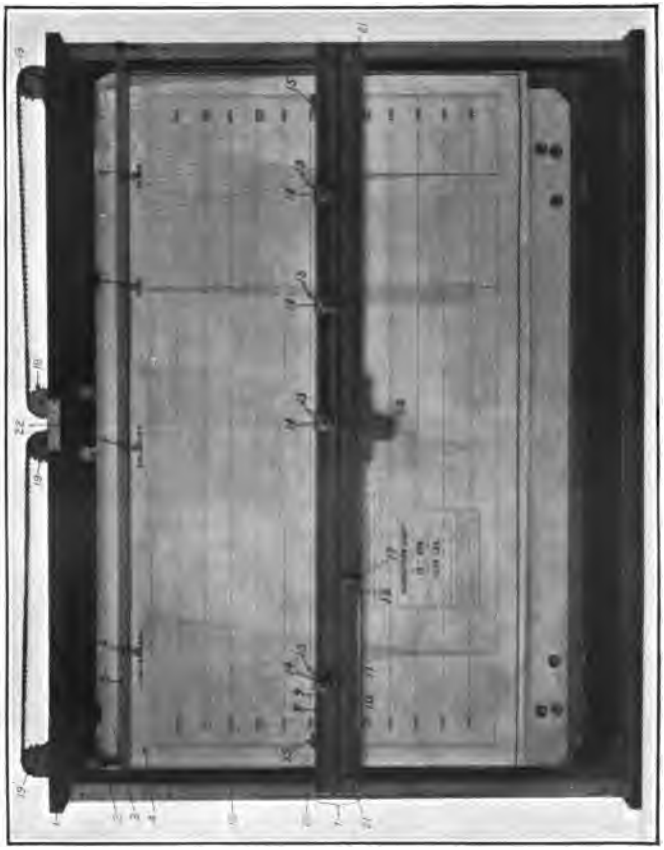


Fig. 8.

clamped to both bars, locks the whole system and is called the locking pointer. To expedite operation, outside pointers are alternated as the locking pointer. All other pointers are clamped to the fixed bar. The provision for locking to both bars serves two purposes; first, to provide against shifting the pointer when passing from one clamped position to the other; and second, to prevent the system from getting out of adjustment.

The gear system is designed to move by turning the knob, the pointers carried on the movable bar and the movable range scale simultaneously, the former moving twice the distance of the latter. The displacement of the latter records the aggregate motion of the pointers. The knob must never be turned, except when adjusting, while all four pointers are clamped to the fixed bar.

One end of each sprocket chain is attached to the counterweight. Both chains pass up through the middle of the top of the box, separate, and each passes over two sprocket wheels, thence down through the top of the box, and each is attached at its other end to an end of the correction ruler. The ruler can be moved up or down immediately in front of the correction chart and will remain at any position to which it is set.

Adjustments.—There are two adjustments for the range board.

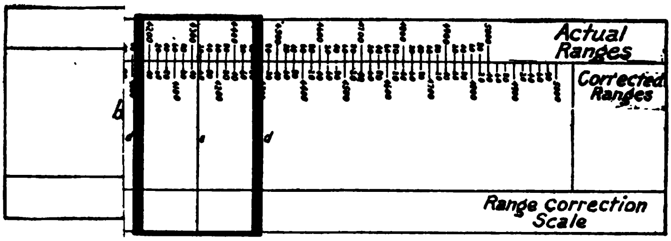
First. Vertical adjustment. With the adjusting screw on one of the sprocket chains, set the two fixed indexes at the same range on the vertical scales on the correction chart.

Second. Horizontal adjustment. Clamp the locking pointer to the movable bar. Turn the knob of the gear system until the pointer is exactly opposite the normal of its set of correction curves. Clamp this pointer to the fixed bar. In like manner set each of the other pointers to the normal of its correction curve and clamp to the fixed bar. When all four pointers are at their normals and clamped to the fixed bar, turn the knob until the movable index indicates the same range on both movable and fixed range scales. Clamp one outside pointer only to both movable and fixed bars, locking the system.

Operation.—Set each marker at its proper correction curve. Set the movable index at the range to the set-forward point on the fixed range scale. Set the fixed indexes of the correction ruler at the range of the set-forward point on both vertical range scales of the correction chart. Clamp the locking pointer to the movable bar, and by means of the knob, set this pointer at the correction curve indicated by this marker. Then clamp to the fixed bar. Proceed in like manner with the other pointers in succession, locking the system with the last outside pointer used. The range on the movable scale at the index under the reading glass is the corrected range. The range board operator transmits this corrected range to the gun emplacements.

NOTE.—In operating the range correction board, it is not necessary to return any pointer to the normal of its set of correction curves. It is necessary only to set the ruler and index at the range for the set-forward point, and move each pointer directly to its proper correction curve. The correction curve is frequently imaginary, and lies between two of the plotted curves in which

a Slide
b Under-cut groove
c Correction index
d Runner
e Range index wire
f Corrected ranges
g Actual ranges
h Range correction scale



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case the pointer is set on the imaginary curve, as indicated by the marker.

Test of accuracy.—There are two tests for accuracy, viz:

For mechanical accuracy: Use each set of test points marked on the correction curves and on the same range line and determine the corrected range. The true corrected range corresponding to each set is shown in brackets on the margin. Repeat several times for each set and record the difference of each determined range from the true range. The mean of these differences is the mechanical error. An officer should conduct this test, exercising the utmost care in operating the board.

For accuracy of the range board operator:

Direct method.—The range board operator uses the test points with the index covered.

Reverse method.—After a series of corrected ranges have been determined by the range board operator, the range officer will set each pointer at the normal of its set of correction curves.

The differences in ranges on the two scales under the index in excess of the mechanical error will be due to inaccurate work on the part of the range board operator.

Other methods of test may be devised if found desirable.

Nomenclature.

1. Box (mahogany).
2. Chart frame.
3. Canvas chart mount.
4. Correction chart.
5. Bar for markers.
6. Markers (curve indicators).
7. Correction ruler.
8. Fixed bar.
9. Movable bar.
10. Fixed range scale.
11. Movable range scale.
12. Knob.
13. Pointers.
14. Clamp.
15. Fixed indexes.
16. Movable index.
17. Reading glass.
18. Chain.
19. Chain sprocket.
20. Chain adjusting screw.
21. Clamping screw.
22. Counterweight (concealed by chart frame).

RANGE BOARD FOR GUNS OF MINOR ARMAMENT.

395. This is shown in figure 9.

Description.—Two fixed scales (*g*) and (*h*), one movable scale (*f*), and index (*c*), a runner (*d*), which carries an index wire (*e*).

Operation.—Battery commander determines range correction and calls it to range keeper, who moves slide "a" until range correction index indicates this correction on range-correction scale. (Range-correction index must be kept set at last range correction given range keeper by battery commander.) Range keeper then slides runner until range-index wire indicates range on "g" called from range finder; he then reads range on "f," indicated by range-index wire, to operator of mechanical transmission device.

TELESCOPE.

396. Figure 10 illustrates the important parts of a telescope.

A telescope is a delicate piece of apparatus and requires careful use. It should never be subjected to unnecessary shock. When not in use it should be kept in the case provided for it or protected

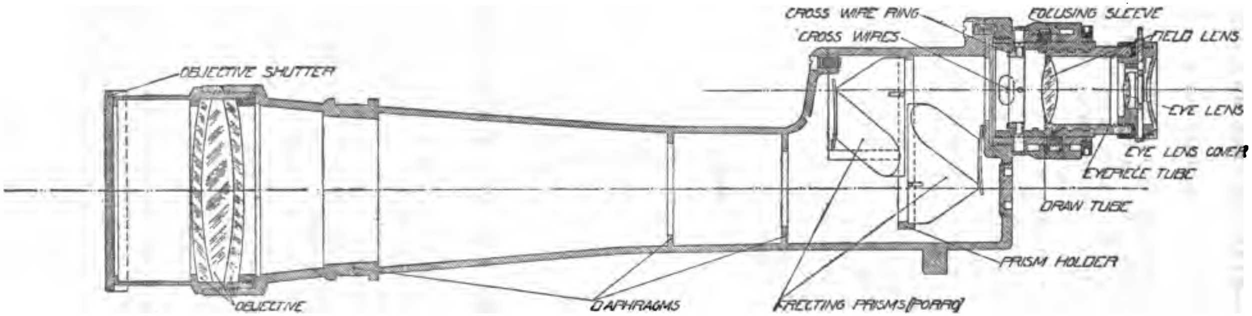

CROSS WIRE RING
CROSS WIRES
FOCUSING SLEEVE
FIELD LENS
OBJECTIVE SHUTTER
EYE LENS
EYE LENS COVER
EYEPIECE TUBE
DRAW TUBE
PRISM HOLDER
OBJECTIVE
DIAPHRAGMS
ERECTING PRISMS (PORRO)

Fig. 10.

by proper covers. Parts liable to rust should be kept lightly oiled; bronze parts should be kept clean and dry. To obtain satisfactory vision absolute cleanliness of the lenses is necessary, and they must be kept free from moisture. Chamois skin or a clean linen handkerchief may be used to remove moisture or particles of dust, care being taken that the lens is not scratched by grit or dirt. The lenses will require cleaning on the inside infrequently, and when this is necessary they should be removed by a competent person. The object glass must be kept screwed home at all times. Erecting prisms, if found in the telescope, should never be removed from the prism holder, nor the objective lenses from the objective cell and ring. If they need repair, report should be made to the proper authority. When the eyepiece of a telescope is removed, the cross wires are generally exposed in the tube. They are very delicate and must not be touched.

In the use of a telescope for coast artillery purposes, two adjustments are necessary:

1. The focusing of the eyepiece so that the cross wires appear clear and distinct; this should be done by pointing the telescope to the sky. It should not be done with any near object in the field of view. Generally the cross wires have more or less roughness on them, which is most clearly seen when the eyepiece is focused properly. Another way of testing this adjustment is to see whether or not the ends of either cross wire appear double or blurred. If so, the adjustment is not perfect.

2. The focusing of the objective so that the object appears clear and distinct. The proper position of the objective to obtain this result will be found most readily by moving it in and out a few times past the proper point. When the image appears to be satisfactory as to clearness the head should be moved from side to side or up and down as far as possible, keeping the image still in view. If the intersection of the cross wires appears to remain upon exactly the same point on the object, the focusing is satisfactory; otherwise not. The adjustment should be repeated until this result is obtained. Apparent motion of the cross wires on the image, due to faulty focusing of the object glass, is spoken of frequently as "parallax." The parallax must be eliminated before satisfactory work can be accomplished.

3. Usually the collimation of the telescope will be correct, but if necessary to adjust it for collimation, the telescope should be leveled and the intersection of the cross wires brought on the target, some well-defined object being used. The telescope is then inverted; that is, turned upside down. If the intersection is not then on the same part of the target, one-half of the discrepancy should be corrected by means of the radial screws in the objective cell ring. The telescope should then be inverted, and the operation repeated until the cross wires remain on the target when the telescope is inverted. The collimation is then correct. Before attempting this adjustment the telescope should be carefully focused. On some instruments this adjustment is impracticable, and the collimation is assumed to be correct.

TELESCOPIC SIGHT.

397. See Ordnance Pamphlets 1952, 1955, 1956, 1958, and 1959. The telescopic sight is attached to the gun carriage, so that its axis may be adjusted to intersect the axis of the gun at or beyond mid-range. Normally it is used to give direction to the gun, the deflection being set on the sight by means of a horizontal scale graduated from 0° to 6°—the 3° point being in the vertical plane containing the axis of the telescope. On some carriages the sight is mounted so that it may be used to give elevation as well as direction. See Telescope.

THERMOMETER.

398. In locating the thermometer in or near the meteorological station, the following should be borne in mind:

First. The temperature of the outside air is required and not the temperature of the station.

Second. The thermometer must be in the shade to obtain the temperature of the air.

Third. The thermometer should not be located where it can be affected by radiation from the walls of the station or by artificial heat from any source.

Fourth. The thermometer should be placed where it is exposed to a fair circulation of air and protected from the sun and rain.

Great accuracy in the determination of atmospheric data is not necessary. Temperature is the most important; a change of 5° has about the same effect upon the range as a 10-mile longitudinal wind; five-tenths of an inch is a corresponding barometric change.

TIME-INTERVAL SYSTEM.

399. See Signal Corps Manual No. 8.

TIME-RANGE BOARD.

DESCRIPTION.

400. The time-range board consists of a blackboard approximately 9 feet by 6 feet in exterior dimensions, over which a T square slides. It is ruled as shown in the accompanying diagram, the vertical lines representing time lines and the horizontal lines representing range lines. The distance between full range lines is 100 yards and the distance between full and broken range lines is 50 yards. The interval between full time lines is 30 seconds, and this interval is subdivided into 10-second intervals by dotted lines.

The T square is constructed as shown in figure 11.

The dimensions of the head "b" are about 1¼ by 5 by 30 inches. It is screwed to the leg "m" and is beveled on the lower edge. It slides on the support "a," and in order to reduce friction to a minimum is provided with a number of friction clips on the lower edge.

TIME-RANGE BOARD

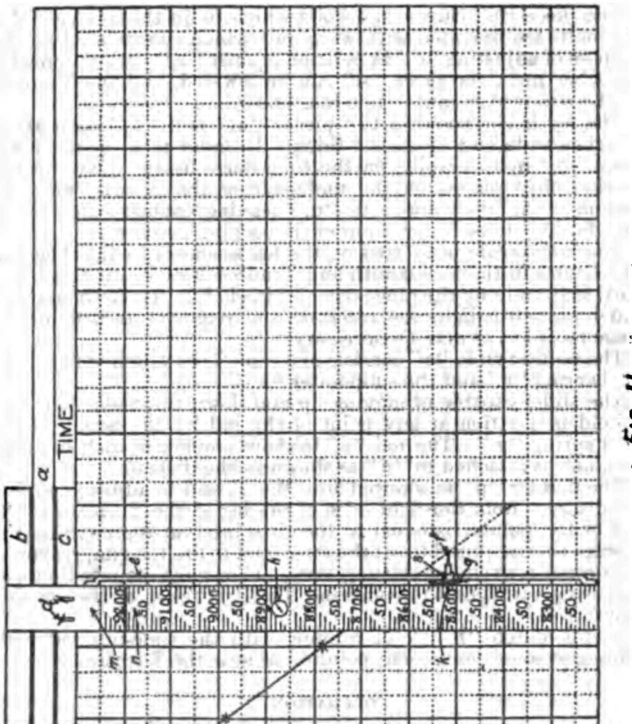


FIG. 11.

The support "a" is about 3½ inches wide and 1½ inches thick. It is screwed to the time-range board, and is beveled on the upper edge.

The adjusting piece "c" is about 1¼ by 2 by 30 inches. On the top edge of "c" there are a number of friction clips which are in light contact with "a."

The piece "c" carries two bolts which fit in the grooves "d." The bolts are provided with wing nuts which can be used for the purpose of adjusting "c" in position against "a." By unscrewing the wing nuts, the piece "c" can be lowered, and the T square can be removed from the time-range board.

The leg is composed of two pieces "m" and "n," each about 6 inches wide and 1¼ inches thick. In order to keep the lower piece "n" from scraping on the time-range board, there are two friction clips placed on the underside of the leg and near the bottom. "m" is screwed to "n," leaving enough space above "n" for "c" to be lowered out of the locking position.

The range scale is painted on the leg as shown in the diagram. The figures in the thousandth and hundredth digits are left blank until written in by the range recorder in chalk. These thousandth and hundredth digits are recorded and removed at will by the range recorder, as may be necessary.

The pointer slide "s" consists of a pipe T, to which is fitted the steel spring "g" and the subpointer "k."

The slide, capable of moving up and down the metal rod "e," is held in position at any point of the rod by the action of the steel spring "g." The rod "e" is about one-fourth inch in diameter, and is attached to "n" as shown in the diagram.

The pointer "p" is screwed into the T, and is adjusted so that the distance from the right edge of the leg of the T square to the end of the pointer is equal to the time interval representing the average time required to set the range and to fire the gun, reckoned from some convenient starting time. (For guns mounted on disappearing carriages, the command TRIP is taken as the starting time.)

A stop watch "h" (kept running with the time-interval bell) is hung at some convenient point on or near the T square.

OPERATION.

(*a*) **Normal method with T square.**—When the first range is received by the range recorder (usually about 20 seconds after the instant of observation) he plots the range by a cross (X) in chalk on the first time line on the left of the board, opposite the proper point on the range scale. This marks the corrected range of the set-forward point for about 10 seconds ahead. Similarly, the second range, when received, is plotted by a cross in chalk on the second time line. A full chalk line is drawn joining the two cross marks, and is prolonged by dots until the dotted line intersects the third time line. This plotting process continues as successive ranges are received by the range recorder until the last time line is reached, or until the plotted time-range line runs off the board, when the range is immediately transferred back to the first time line on the left and near the top or bottom of the board (making the necessary changes in thousandth and hundredth digits on the range scale), and the process is then continued as just described.

The successive plotting of ranges should form a regular curve, the ordinates of which give the corrected ranges of set-forward points for any time of firing. The rate of increase or decrease in range is shown by the curve in such a manner as to be easily noted. Any range error made by the range section is revealed by a sharp break in the regular time-range curve. When such sharp break appears, the range recorder indicates the location of the point on the board by a small circle instead of a cross, but rejects it as a point of the time-range curve and continues the regular curve in a dotted line until it is ascertained precisely whether the break was due to an error or to a sudden change in the course of the target.

In the case of guns mounted on disappearing carriages, when the range recorder hears the command "**TRIP**," he notes the time on the stop watch to the nearest five-second mark and sets the T square so that the right edge of the leg is adjusted to the time noted. He then moves the slide so that the end of the pointer touches the time-range curve. The subpointer now indicates the corrected range of the set-forward point for the instant of firing, and the range setter uses this range for setting the gun-range scale.

After the T square and subpointer are set they are not moved until after the command "**READY**," has been given.

No range is set on the gun-range scale until the command "**TRIP**," After the gun commander notes whether the gun goes fully into battery, he verifies the range setting. In case the range setting is wrong, he causes the range setter to correct it instantly and, if necessary, requires the range recorder to reset his T square. After verifying the setting, the gun commander calls "**READY**," and the gun pointer fires the gun, or, if friction primer has to be used, gives the command "**FIRE**," as soon thereafter as the gun is pointed.

In case of guns mounted on barbette carriages, the operation is the same except that the T square is set on a *selected starting time* instead of at the command "**TRIP**," and the gun commander does not verify the range.

The range recorder stands in such position as will not interfere with the range setter's seeing the range indicated by the subpointer.

(*a*) **Alternative method without T square.**—The following method of using the time-range board without the T square is authorized:

The time-range curve is plotted as prescribed in (*a*). In this case, the ranges are placed on the time-range board instead of on the T square.

At a selected starting time (for example, the command TRIP) the range-setter (or some other member of the gun section to be designated by the battery commander), takes from the time-range curve, the corrected range of the set-forward point which will be the correct range setting if the gun is fired a certain definite number of seconds after the starting time (for example, 15 seconds). This range is set on the gun range scale.

The gun commander notes whether the gun goes fully into battery, verifies the range setting, and calls "READY in time for the gun to be fired at the time corresponding to the range setting.

In case of a delay so that the gun can not be fired at the correct time, a new range for a definite number of seconds ahead is taken from the time-range curve.

WIND COMPONENT INDICATOR.

(See Ordnance Pamphlet 1794.)

401. The object of this device is to determine the wind reference numbers to be used on the range and deflection boards and to indicate the numbers to the operators of these boards.

It consists of a circular dial (A), figure 12, on the face of which the reference numbers are marked with corresponding horizontal and vertical lines. The dial is intended to be held in a vertical position by means of a bracket (M) screwed to the wall and fastened to the back of the dial in such a way that the dial itself will not turn; hence the figures it carries will be right side up always.

Around the dial is the movable azimuth ring (B), graduated and numbered clockwise every 5°. This ring can be set so that the wind azimuth pointer (K) at the bottom of the dial points to any required wind azimuth. The ring can be clamped in position by a clamp screw at the back of the plate immediately behind the wind azimuth index.

Embracing both dial and ring and rotating about an axle at the back of the dial is the target arm (C′). The target arm is centered in front by the screw (D), which passes through the end of it into the center of the dial. It has a clamp screw, by means of which it may be clamped at any desired azimuth, indicated by the azimuth index (C).

The pointer (HH′) passes through a slot in the square projection on the end of the target arm and can be set to indicate any wind velocity from 0 to 50 miles per hour by means of the wind scale on the target arm, using the end H of the pointer as an index. The reference numbers to be used on the range and deflection boards are indicated by the end (H′) of the pointer. The instrument is intended to be suspended from the ceiling immediately over the plotting board and facing the range and deflection boards, so that the operators of these boards can read the range and deflection components without leaving their positions.

The operator sets the pointer (H) to the wind velocity, and by turning the azimuth ring brings the wind azimuth to the pointer (K). He keeps the target arm set to the approximate azimuth to the target, as indicated by the gun arm, using the index (C) and moving the target arm as the target moves. Should the wind change in velocity or direction, he makes the corresponding change on the board.

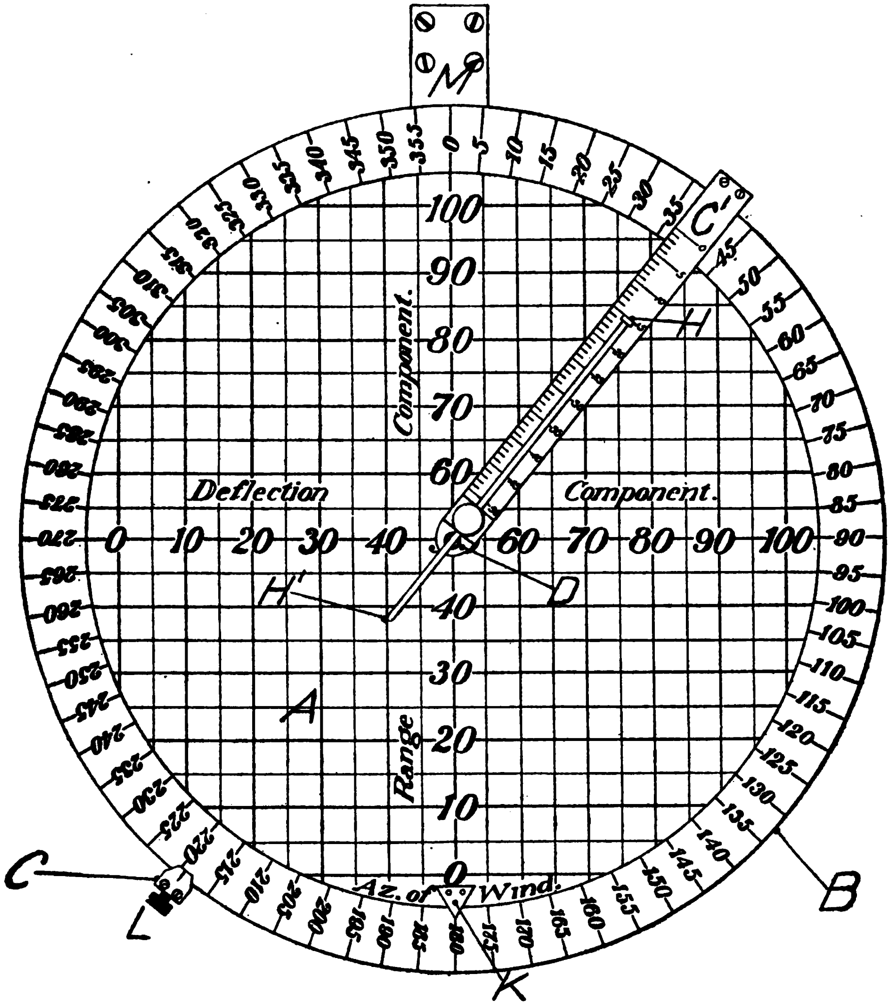

M
C'
H
Component.
Deflection
Component.
Range
H'
D
A
C
L
B
K
Az. of Wind.
0
10
20
30
40
50
60
70
80
90
100

Fig. 12.

WIND VANE.

402. This is a device for determining the direction of the wind. It should be remembered that the mean direction of the wind is desired. The ordinary fluctuations in direction are due usually to local causes near the surface of the earth and have but little effect upon the flight of the projectile. A true fish-tail wind undoubtedly produces varying results, but it is not practicable to do anything other than consider its mean direction. The observer should watch carefully the movement of the vane and endeavor to obtain the true mean. It will be found useful to make chalk marks indicating the observed swing of the vane, by means of which the mean direction can be determined.

Chapter XXIV.

CARE OF MATÉRIEL.

GENERAL INSTRUCTIONS.

403. Officers will be held to a strict responsibility for the proper care and preservation of all coast artillery matériel in their charge. Any damage to or defect in property will be reported to the proper representative of the supply department concerned.

404. The methods prescribed for the operation, care, and preservation of matériel are those described herein, and those contained in the publications issued by the War Department and the supply departments, a thorough knowledge of which is required on the part of all officers and others having such matériel in charge.

405. Batteries are "in service" when they are used at daily drill by coast artillery manning parties. Batteries are "out of service" when they are in the hands of a caretaking detachment. A battery is "out of commission" when it is not in serviceable condition. All batteries in condition for service are "in commission" whether "in service" or "out of service."

406. Battery commanders will be responsible for the ordnance property pertaining to the batteries in service, and ordnance officers for the ordnance property pertaining to those batteries out of service.

SUPPLY DEPARTMENTS.

407. The Engineer Department erects, alters, and maintains all emplacements, and all fire-control, searchlight, fortification power plants, and submarine mining structures.

408. The Engineer Department supplies, installs, and maintains the following:

Ammunition hoists, trolley systems, mechanical range indicators, and searchlight and fortification light and power equipment (except signal corps storage batteries and mechanism for operating fire control apparatus, mining casemate equipment for operating the mine system, and ordnance motors for operating guns).

It installs underground communication lines.

It supplies the following:

Circular benches for observing instruments and plotting boards; rubber matting or other approved floor covering for the floors of fire-control stations and fortification power rooms; reserve or emergency lanterns.

Material for the construction of time-range and deflection recorders' boards.

Lumber for piling projectiles.

Lumber, hardware, paints, and other materials and supplies for the preservation and upkeep of batteries and structures (fire-control, searchlight, fortification power plant, submarine mining, and others).

Electrical and other supplies for the maintenance, repair, and operation of searchlight and fortification light and power equipment.

Lubricating oil for 25 k.w. gasoline generating sets.

Spare parts for ammunition hoists, trolley systems, searchlight and fortification light and power equipment.

Special tools for use with equipment furnished by the Engineer Department.

409. The Ordnance Department supplies and maintains the following:

Guns and mortars and their carriages and accessories; tools and implements for the service thereof; ammunition; targets; also fire control apparatus (except that pertaining to communications, time-interval system, signaling and meteorological data), and in addition observation telescopes; stop watches; cameras and camera supplies; drawing boards and drawing instruments; thermometers and hygrometers; magnetos for firing; firing batteries; bench and hand tools (not furnished with machines) and appliances for fortification power plants and ordnance repair shops; stencils and figures for marking guns and emplacements.

It installs motors on the gun carriages, their circuits on the gun carriages, wiring for firing circuits and illuminating circuits on carriages, and position-finding instruments.

It furnishes the maintenance supplies given in the following table:

Supplies.	Use.
Paints	For guns, carriages, projectiles, and position-finding instruments.
Oils for paints	Do.
Lubricating oils	Do.
Hydrolene oil	For recoil cylinders, gun carriages.
Slushing oil	For guns and carriages.
Kerosene	For cleaning recoil cylinders and guns.
Abrasives	For removing old paint from the guns, carriages, sights, position finders; and for cleaning and polishing bright metallic surfaces.
Paulins	For gun covers.
Rope, blocks, gins, etc	For mechanical maneuvers.
Draftsman's supplies	For battery charts.
Chalk	For recording firing data at emplacements.
Miscellaneous.	
Cleaning material: Sal soda, quicklime, powdered lye, chamois skins, burlap, flax twine, packing needles, putty, cotton waste (white), cotton waste (cop), lumber, nails, screws, paint pots, sieves, brushes, corn brooms, whisk brooms, hand sponges, paper (for lenses).	For cleaning, painting, and packing guns and carriages, and position finders, etc.
Oil storage tanks (30 and 60 gallons), funnels, and measures.	For storage of oil at batteries.
Plumbers' force pumps and hose	For cleaning recoil cylinders.
Scales	For weighing powder and projectiles.
Testing sets	For testing cartridge storage cases and metal-lined boxes.

For detailed information in regard to allowance of materials enumerated above, see Ordnance Pamphlet 1869 and drawing 27-5-1 of latest revision. In case of conflict between pamphlet and drawing, allowances as shown on drawing will govern.

410. The Signal Corps supplies the following:

Fire control apparatus pertaining to communications, time-interval system, signaling, and meteorological data.

It supplies field glasses, portable ammeters and voltmeters, all cable for communications.

411. The Quartermaster Corps supplies the following:

Furniture (except floor covering or circular benches for fire control stations), stoves, scythes, sickles, shovels, rakes, fuel-handling apparatus, fire tools, wheelbarrows, etc.

For power and electric plants maintained by the Quartermaster Department: Paints, fuel, lubricating oil, kerosene, oil-storage tanks, spare parts (for engines, generators, boilers, and accessories), brooms, Sapolio, brushes, soap, mops, sal soda, and waste.

For police of fire-control stations: Brooms, Sapolio, brushes, soap, mops, sal soda, and waste.

REGULATIONS PERTAINING TO ENGINEER DEPARTMENT PROPERTY AND INSTALLATIONS.

412. Coast defense structures, and the grounds surrounding them whose limits are prescribed by fort commanders, will be kept in proper police.

413. All open drains or gutters will be carefully swept at least once a week, and the sweepings so disposed of that they will not be carried back by wind and water.

414. Under no circumstances will drains, gutters, sumps, counterweight wells, etc., be used as places of deposit for sweepings, waste, rags, and other rubbish. Drains and sumps will be inspected weekly, and will be kept in good order. Water fixtures will be inspected weekly, and leaky fixtures will be promptly repaired to avoid waste of water and possible damage.

415. In freezing weather water will be shut off and pipes and fixtures properly drained at the valves provided for this purpose.

416. After rains, earth slopes and parapets will be inspected and any tendency to gully and wash will be corrected at once or will be immediately reported.

417. Walking on the earth slopes will not be permitted, except as may be necessary for their inspection, care, and repair.

418. Dry grass, weeds, etc., in the vicinity of structures that might increase the danger of fire will be cut and removed.

419. Before firing service charges, doors and windows in batteries and adjacent structures will be opened and properly secured, in order to minimize damage from blast.

420. All machinery, such as boilers, engines, generators, pumps, etc., will be kept in good working order at all times; electric light and power equipment will be put in operation at least once a month, and where machinery is not connected with its source of power it will be turned over by hand.

421. The ammunition-service apparatus (trolleys, motors, and hoist) will be operated at least once each week, and the different working parts (pulleys, journals, etc.) will be kept clean and lubricated. Special care will be exercised in operating the motor starter and in preventing the jamming of any part of the hoist; also in the handling of projectiles at the receiving and delivery tables. The Hodges ammunition hoist is not designed and must not be used for lowering projectiles, either by motor or by hand power. The Taylor-Raymond ammunition hoist may be used with safety to lower projectiles by hand power, provided care be exercised and the hoist operated slowly; but the hoist must not be used to lower projectiles by motor power. Where emplacements are provided with cranes these will be used in preference to the Taylor-Raymond hoist for lowering projectiles.

For care of hoists, see Engineer Mimeographs, Nos. 46 and 137, and supplements.

REGULATIONS PERTAINING TO ORDNANCE DEPARTMENT PROPERTY AND INSTALLATIONS.

422. Pamphlets and publications descriptive of ordnance material and containing instructions relative to caring for, mounting, and using guns, mortars, their carriages and accessories, are issued by the Ordnance Department as listed in Ordnance Department Pamphlet No. 1467.

423. Oils (see Ordnance Pamphlet No. 1869).—The important oils and lubricants supplied and uses therefor are shown in the following table:

Name.	Use.
Hydrolene	For filling recoil cylinders and for sponging powder chamber between rounds only.
Kerosene	For cleaning purposes only, especially recoil cylinders.
Light slushing	For the bore and for the bright parts of guns and carriages when they are to remain unused for a considerable time.
Engine	For bright parts of guns and carriages when in daily use. For lubricating purposes where oil holes or plugs are provided.
No. 4½ lubricant	For filling grease cups of heavy bearings.
Turpentine	For thinning paint.
Clock	For bearings of sights, position finders, etc.
Graphite	For use on heavy bearings in connection with 4½ lubricant, proportion 5 per cent graphite to 95 per cent lubricant by volume. Also for use on gas check pads, proportion 50 per cent graphite and 50 per cent lubricant by weight.

Oils will be kept in closed receptacles, free from contamination, and will not be used a second time unless strained carefully. Discoloration does not in itself affect the serviceability of oils.

424. Painting.—For allowances and preparation of paints, see Ordnance Pamphlet 1869.

425. Painting guns and mortars.—In general, three coats of paint will be given guns and mortars the first year that they are mounted; thereafter one or two coats annually will suffice, the actual needs depending upon the climate and local conditions.

As soon as the piece is mounted on its carriage, all parts which have been marred in transportation will be primed, after which one complete coat of the gray paint will be applied.

The entire external surfaces of guns and mortars, except oil holes in breech plates and except the portions where the tray or block carrier bears, will be painted gray. When detached quadrants are used with mortars, the seats for the quadrants will be left unpainted. Before painting, the surfaces will be rubbed smooth and made perfectly *clean* and *dry*. Special care will be exercised to prevent painting contact surfaces forming part of an electrical circuit. Cross lines on muzzle and breech faces should be free from paint. Grooves in the breech face should not be painted.

Bronze trays will not be painted. Steel trays, excepting the upper and front surfaces and guide rails will be painted the same color as the gun. No parts of the breechblock or mechanism will be painted. The unpainted surfaces will be kept clean and bright with oil or pomade.

The elevating bands of pieces mounted on disappearing carriages and the elevating racks attached to pieces mounted on mortar and barbette carriages will be painted the same color as the guns or mortars, leaving the bearing surfaces of the teeth unpainted.

426. Painting carriages.—The number of coats of paint required for carriages is the same as that for guns and mortars. Before painting, surfaces will be rubbed smooth and made perfectly clean and dry. As soon as the carriage is assembled completely and the piece mounted, all parts which have been marred in transportation will be primed, after which one complete coat of olive green paint will be applied. In applying this paint the utmost care will be taken to avoid interference of proper functioning of moving parts, and also to avoid getting paint into oil holes or bearings.

All steel and iron nonbearing surfaces, both inside and out, will be painted. This includes the exposed parts of shafts (except squared ends), bottom plate of counterweight, ladders, springs, crossheads, cranks (not handles), crosshead pawls (except teeth), and large bronze pieces, including web and spokes of wheels and cylinder heads.

The following parts will not be painted: All wearing or bearing surfaces, which include the handles of handwheels and cranks teeth of all gear wheels, teeth of crosshead pawls and safety latches teeth of crossheads, elevating-rack guides, rollers and surfaces on which they travel, piston rods, crosshead guides, etc.

Bronze sight holders will not be painted, nor will azimuth and, elevation scales and pointers, nor followers of stuffing boxes; these, parts, with the exception of sight holders, will be kept clean and bright with oil or pomade. Scales should be clean but not polished, as the reflected light is liable to interfere with reading the scale.

Name and direction plates for carriages, and trunnion brackets for telescopic sights will not be removed. Name and direction plates will be painted, but the raised surfaces of the letters and figures will be kept polished. Trunnion brackets will not be painted.

427. The paints mentioned are supplied in original packages, mixed ready for use. In all cases before using, the contents of the package will be stirred thoroughly with a wooden paddle; if thinning is desired, turpentine or other authorized liquid will be used. Care will be exercised to have the paint of the proper consistency before it is applied.

428. **To remove old paint from guns and carriages.**—When the paint becomes so thick as to scale off in places or to give an unsightly appearance, as is the case after a number of coats have been applied to guns and carriages, it will be removed for repainting as follows:

Dissolve 1 pound of concentrated lye, powdered form, in 6 pints of hot water and add enough lime to give the solution the consistency of paint. Apply this solution, freshly mixed, to the parts where paint is to be removed with a brush or with waste tied on the end of a stick. When the solution begins to dry on the surface use a scraper to remove the old paint and complete the cleaning of the surface with a mop and water. If one application is not sufficient to loosen the paint, apply a second coat. Before applying a new coat of paint, wash the surface with a solution made by dissolving one-half pound of washing or sal soda in 8 quarts of water and wipe as dry as possible. Let stand a sufficient length of time, so that all parts will be thoroughly dry before painting.

429. **Marking guns, mortars, and mortar pits.**—At all coast artillery posts the position of every gun, mounted or to be mounted, will be given a number. When the gun is in position this number will be placed on it.

430. Guns arranged in line will be numbered from right to left in separate series for each battery.

431. The two pits of each mortar battery will be lettered from right to left or from rear to front A and B. When there are four mortars in each pit, they will be numbered as follows:

No. 1. The right rear mortar.
No. 2. The right front mortar.
No. 3. The left rear mortar.
No. 4. The left front mortar.

When there are two mortars in each pit, they will be numbered from right to left.

432. The mortar-pit letter will be painted with its median line on the median line of the front vertical wall or interior slope of the pit and with its middle point about 10 feet above the floor. The letter will be block, 10 inches high and 8 inches wide, and painted in white on circular black background, 16 inches in diameter. The mortar number will be painted with its median line on the upper element of the mortar, half way between the median circular element of the trunnion band and the face of the breech, the top

of the figure being toward the trunnion band. The number will be white block, 4 inches high.

433. The tactical numbers of guns will be located on the gun or carriage so as to be visible easily from the rear, the location on each class of gun and carriage in a coast defense command being uniform and as prescribed by the coast defense commander. The numbers will be white block, 1½ inches high.

434. **Care of guns and mortars.**—Parts of seacoast cannon are not expendable, and irrespective of their condition are borne on property returns.

435. All guns "in commission" mounted on disappearing carriages will be tripped, elevated, depressed, and traversed between limits once a week when practicable.

436. All guns "in commission" mounted on barbette carriages will be elevated, depressed, and traversed between limits once a week when practicable, and will be drawn back approximately to normal recoil (and released) at least once every three months.

437. No part of the piece will be allowed to rust at any time, and if it is to remain unused for considerable intervals all bright and bearing parts will be covered with a coat of light slushing oil. For the bore, two applications per year are considered sufficient; for surfaces exposed to the weather four applications may be required.

438. To oil the bore, an ordinary counterbrush is used; it is secured to the end of a rod and provided with a half disk of wood to keep it against the bore. By this means any required thickness may be applied. The brush rod for guns is fitted with a socket for connecting it with the special sponge staff. For mortars, the brush is supplied with a special handle.

439. To remove the greater portion of the slushing oil from the bore, an iron scraper is used. For guns, it is fitted for attachment to the staff of the special sponge. For mortars, it is provided with a shaft 14 feet in length. The entire removal of the oil and residue from the bore by hand is necessary for star gauging, firing, and after firing before oiling the bore. After the greater portion of the slushing oil is removed with a scraper, a sponge is dipped in a solution of concentrated lye and passed through the bore. This softens and partially dissolves the coating. Then additional burlap is placed on the sponge, the whole being made of such diameter that it requires eight or ten men to pass it through the bore, since considerable pressure is necessary in order to reach the bottom of the grooves. The bore will be wiped perfectly dry before firing.

440. After firing, the powder residue will be removed by using the sponges well saturated with water. The sponges will be covered with sufficient burlap to make them a snug fit and insure reaching the bottoms of the rifling grooves. Flushing the bore with a hose immediately after firing facilitates cleaning.

441. The habitual position of guns on disappearing carriages will be "from battery." Guns on barbette carriages will be given an elevation of 5°.

442. All mortars (except model 1908) will be elevated habitually, so that their axis will be parallel to the piston rod. The breech cover will be left off and the translating roller will be left in place. At forts where the sand blows into the breech mechanism and at

all forts during the cold season where snow and ice may collect and form around the breech mechanism, the mortar will be kept elevated about 5° with the breech cover on. Model 1908 mortars will be kept elevated about 5° with the breech cover on.

443. Care of carriages.—When in use, all bearing parts will be cleaned and lubricated thoroughly. In all carriages, special attention will be given to the lubrication of gun trunnions, rollers, pintle surfaces, sliding surfaces, elevating, loading, and traversing mechanisms, including the teeth of all gears. On disappearing carriages, the following parts will be lubricated also: Gun-lever axle bearings, crosshead pins, tripping and retracting mechanisms, elevating rack and band trunnions, and crosshead guides.

Oil holes where provided will be cleaned out frequently to keep them free from sand and grit, and kept closed habitually by the screw plugs or covers provided except during oiling.

Before oiling at any oil hole, wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.

444. Compression grease cups will be filled with No. 41 lubricant. The caps will then be screwed down on the cup until the spring rod projects about 0.25 inches above the top of the cap. This adjustment will be made from day to day, as required to maintain about this projection for the rod.

445. Care will be exercised that no water is allowed to enter the recoil cylinders when they are filled with oil or at any other time, for this will cause rusting of the interior of the cylinders, and in cold weather it may freeze and burst the equalizing pipes or other parts of the recoil system.

446. Experience has indicated that the oil should not be removed from recoil cylinders when carriages are to remain unused for a considerable period, as the walls of the cylinders soon become dry and rust. For this reason, any leakage will be promptly replaced.

447. Garlock's (or equal) waterproof hydraulic packing is furnished for packing all stuffing boxes of gun carriages.

448. All motors installed on gun carriages will be operated at least once each week if practicable, for such length of time as will insure that they are in working order. When exposed to excessive moisture they will be operated for such further length of time as may be necessary to prevent accumulation of moisture in the motor cases.

449. If rust is allowed to accumulate on carriages, its removal from all bearing parts, especially piston rods and teeth of gears and racks, requires particular attention in order that clearances may not be increased unduly. Emery cloth No. 1 is coarse enough for removal of ordinary rust, the rust being softened, if necessary, by kerosene.

The use of sandpaper for this purpose is forbidden.

450. On all seacoast gun carriages, special care will be exercised to insure that bolts passing into hydraulic cylinders are tight at all times.

451. Mortars will be raised from their trunnion beds at least once every two years, or more frequently if necessary, and trunnion beds cleaned thoroughly, including the oil grooves in the trunnion-bed liners. Once every two years, mortars will be dismounted, the carriage cleaned and overhauled, and the old paint removed from the counter-recoil springs, which will be given two coats of new paint. The springs will not be reassembled until the paint is dry. A record of the dismounting and cleaning will be kept in the emplacement book. Care should be taken to reassemble springs in the same relative positions they were in on disassembling.

The method for dismounting mortars and cleaning springs is described in the Ordnance pamphlets on the mortar carriages.

452. **Cleaning of recoil cylinders.**—Recoil cylinders will be cleaned at least twice each year, when practicable.

The methods for cleaning recoil cylinders are described in the Ordnance pamphlets for the various models of carriages in use.

It is not necessary to remove the packing from stuffing boxes in order to clean the cylinders.

453. **Dismantling breechblocks of heavy cannon.**—Open breech; remove the firing attachment, and place a shot truck with its tray under the mushroom head, elevating the tray until it bears the weight of the mushroom head and spindle. Remove the spindle nut and move truck back so as to withdraw the spindle from the block. Remove the split rings, gas check pad, and filling-in disk.

454. To assemble, proceed in the reverse order. The firing attachment should not be placed on spindle until the mushroom head has been adjusted.

455. For further instructions in dismantling, dismounting, and caring for breechblocks, see Ordnance Pamphlet on Breech Mechanism for Seacoast Cannon, No. 1665.

456. **Gas check pads.**—These pads are now issued in sealed containers which will not be opened until the pad is required for use. After removal from containers, pads will be coated with a thoroughly incorporated mixture of equal parts by weight of graphite and 44 lubricant. The mixture will be evenly and liberally applied to the entire surface and will be rubbed into the pad covering with the fingers, leaving no lumps. The object is to reduce absorption of moisture and cutting or tearing. About two ounces are required for a 12-inch mortar pad; others in proportion. The coating will be renewed as required and carefully renewed when the use of the gun is discontinued for a considerable time.

457. **To adjust the gas check pad.**—Close the breech with the spindle nut loose, but not loose enough to permit slipping of the pad or split rings, rotate the block one-half. With the mechanism in this position screw up the spindle nut as tight as it can be screwed with the wrenches provided.

It may be necessary to insert the end of a screw driver in the opening of the nut in order to spread it sufficiently to allow its rotation without rotating the spindle.

Clamp the spindle nut and rotate the breechblock until the breech is closed completely. This last operation presses the pad into its seat, due to the forward motion of the block.

Then the pad should be in proper adjustment for firing; this may be tested by turning the mushroom head by hand. It should turn easily, but without play.

458. **Examination of the breech mechanism of mounted guns.**—The breech mechanism of mounted guns will be operated at least

once each week, when practicable, and such parts of it as need cleaning will receive proper attention. If necessary, the tray will be removed in order to clean the worm, worm shaft, the spiral gear, and their recesses.

459. The mechanism will be oiled frequently, especially the filling-in disk, the worm shaft, ball bearings, and the hinge pin; engine oil is issued for this purpose. A mixture of 4½ lubricant and graphite is used on translating rollers. Special care will be taken to keep the primer seats clean and well oiled. Neglect of this permits rust, the removal of which enlarges the seat sufficiently to cause primers to stick.

460. Firing mechanisms.—Firing mechanisms will not be left on any gun or mortar out of service, but will be kept dismantled in the box provided for the purpose. All parts will be kept oiled and entirely free from dust.

461. Piling projectiles.—Projectiles when received at a fort will be unboxed and piled on suitable skidding with points to the wall, base out, so that they may be inspected and fused easily. Care will be taken not to injure rotating bands. (See pars. 569 to 574, inclusive.)

462. Packing boxes for projectiles.—A reasonable supply of the packing boxes in which projectiles are received will be kept on hand by the coast defense ordnance officer for making shipments.

463. Painting projectiles.—Projectiles will be painted as prescribed in Ordnance Pamphlet 1868, and in case the galleries are wet the projectiles after painting will be slushed. The distinctive color to indicate the character of the bursting charges is not applied until the projectiles have been filled, after which the entire base of each projectile will be painted the required color at once.

464. Loading projectiles.—Instructions for loading projectiles with high explosives are contained in Ordnance Pamphlet No. 1721.

465. Dummy projectiles.—Dummy projectiles, in order to work well, require that the bands be reasonably round and of sufficient diameter to make the projectile seat at about the position in the gun originally intended, and that the springs be of full strength. A little kerosene will be poured under the rotating band before each day's drill to cut any rust which may have formed and thus insure uniform conditions from day to day. The detailed methods of caring for these projectiles, outlined in Ordnance Pamphlet 1872, will be followed.

466. Care of empty metallic cases and primers.—After the expenditure of ammunition with guns using metallic cartridge cases, the empty cases will be taken up on the property returns of coast defenses as "empty metallic cartridge cases," under the heading provided for that purpose. Immediately after firing, the cases will be decapped, cleaned well by washing inside and out, and dried.

All obturating electric and friction primer cases will be cleaned immediately after firing and turned in to the coast defense ordnance officer for shipment to an arsenal.

467. Care of telescopes.—The prisms and lenses in the telescopes of position finders, azimuth instruments, and sights are not arranged for adjustment by those using them; the taking apart of telescopes for any purpose, and the making of any adjustments other than those provided for in their construction and described in Ordnance Pamphlets (1795 and those describing sight or instrument to which the telescope pertains), except under the supervision of district armament officers, are forbidden.

When telescopes or any instruments of the range-finding and fire-control system for coast artillery issued by the Ordnance Department require repair, a report describing the character and extent of the injuries or defects will be made to the armament officer of the district. In case the repairs or adjustments required by telescopes and other delicate instruments of precision are of such a nature that they can not be made at the fort, the instruments will be shipped by express to such arsenal as may be designated by the district armament officer. Since exposure to moisture and dust results in serious injury to lenses of optical instruments, covers will be kept on except when the instruments are in use.

468. Paulins.—Specially shaped paulins for the protection of seacoast guns and carriages at fortifications on the Atlantic coast north of the fortieth parallel of latitude are provided by the Ordnance Department upon requisition. Paulins for other fortifications than those named above or for other purposes are provided only in cases of extreme necessity, which should be explained fully in each instance.

469. Instructions pertaining to property supplied by the Signal Corps.—For detailed instructions regarding the installation, use, care, and preservation of Signal Corps property see Signal Corps Manual No. 8.

CARETAKER DETACHMENTS.

470. The duties to be performed by caretaker detachments will consist of:

(*a*) Care, preservation, and protection of all Government property.

(*b*) General police of the batteries, power plants, observing stations, and other public buildings and their immediate surroundings.

(*c*) Enforcing the regulations relating to persons coming on Government reservations and visiting or inspecting the batteries or buildings.

471. The care of a battery includes, in addition to the care of the battery proper and its armament, the care of all buildings, rooms, observing stations, and plotting rooms pertaining thereto and of the contents thereof.

The care and preservation of all ordnance property will be in the charge of an ordnance sergeant when practicable.

The care and preservation of all engineer and signal property will be in the charge of an electrician sergeant when practicable.

472. The general protection of all Government property and the police of batteries, buildings, and surroundings will be in the charge of a noncommissioned officer of coast artillery, who will also be in command of a detachment of privates of coast artillery detailed to assist the ordnance sergeant in the care and preservation of the public property in his charge, to guard the reservation against the intrusion of unauthorized persons, and to police the batteries, buildings, and grounds.

473. At forts where an ordnance or electrician sergeant is not provided, the noncommissioned officer of coast artillery in command of the coast artillery detachment will act as such.

474. The composition of coast artillery detachments to assist ordnance sergeants will be determined on the following basis: One private to every 2 guns of 5-inch or greater caliber; 1 private to every 2 mortars; 1 private to each rapid-fire battery of 4 guns or less below 5-inch in caliber; *provided*, that in no case will a caretaker detachment consist of less than 1 noncommissioned officer and 3 privates.

475. One private, in addition to those authorized in the preceding paragraph, will be detailed to cook for the detachment when it messes separately.

476. The noncommissioned officer of coast artillery in command of the coast artillery detachment will be held responsible for the good order and military disclipine of his detachment. He will detail the privates of the detachment as watchmen of the batteries, buildings, and grounds in accordance with a roster kept for that purpose. At least one man will be on watch at all times. The watch tour is of such duration as the commanding officer of the coast defenses may prescribe, not to exceed eight hours. During the time that a man is on watch he will make the rounds as prescribed by the coast defense commander.

477. Each coast defense commander, in person, will make, once a month, a thorough technical inspection of all coast artillery matériel installed at the ungarrisoned forts of his command, of caretaker detachments and their quarters. Coast artillery matériel at such posts will be required to be maintained by caretakers at the same standard of condition as to appearance and functioning as that assigned to companies.

Chapter XXV.

STORAGE AND CARE OF EXPLOSIVES.

GENERAL INSTRUCTIONS.

478. At least once each calendar month, each officer responsible for the care of explosives stored at forts will inspect personally each place where the explosives are stored. At this inspection, he will see that the requirements of these instructions for the storage and care of explosives are being observed carefully. He will report to his fort commander the result of his inspection.

479. All dirt, grit, and foreign material will be removed from cases before placing them in storage. In handling cases containing explosives, they will be raised, carried to the new position, and gently lowered. Rolling, sliding, or dropping cases must be avoided.

480. One of the most important requirements in the care of any explosive is absolute cleanliness in and about the place where the explosive is stored. By removing all foreign materials from a magazine, the chances of accidents are reduced. The ground around the storage place will be kept free from leaves, long grass, brush, débris, or anything which may increase the fire risks.

481. Officers charged with the receipt and storage of explosives will direct personally the work of handling the cases.

482. Cases will never be exposed to the direct rays of the sun longer than is absolutely necessary. They will be covered with a paulin or similar cover in such a way as to admit of the free circulation of air. The effect of the direct rays of the sun on a metallic case is to raise the temperature inside the case to a point considerably above that of the open air, and this temperature is maintained for a considerable time after the exposure.

483. In opening cases, implements which may produce sparks will not be used. Suitable implements are a wooden mallet, or a copper hammer with a wooden wedge or copper chisel. A hammer will be used only when necessary, and then as lightly as possible.

484. The keys of magazines and storage places will be kept in the hands of thoroughly reliable and responsible persons.

485. Whenever there is more than one kind of explosive in a storage place, but one kind will be placed in a pile, and the different kinds separated as much as possible.

486. The date of the receipt of any explosive at a fort will be marked on the outside of the container. Each separate package will be marked.

487. Only those explosives mentioned herein as being suitable for storage together will be placed in any single storage place.

488. Free circulation of dry air is most desirable in any place where explosives are stored. Cases will always be raised off the floor of the storage place and placed on skids.

489. If a storage place is artificially heated, or from climatic conditions the temperature of the air is liable to rise above 85° F., a maximum thermometer will be suspended therein, the temperature will be watched carefully during the period of excessive heat, and the daily readings will be recorded on the proper Ordnance Department form. Should a temperature as high as 100° F. be maintained for any length of time, the place will be cooled or the explosive removed.

490. Black powder is now supplied to the service in relatively small quantities. It will never be stored with other explosives. It will be kept dry, and on account of the danger of explosion by ignition will be protected thoroughly from all fire risks.

491. Matches and unauthorized lights will not be permitted in any magazine.

492. No loose explosive will be permitted in any building, except such as is being used actually in preparing charges.

493. Empty ammunition cases will never be stored with filled cases.

494. A copy of these instructions will be hung in a convenient place in every magazine containing explosive, for the information and guidance of all concerned.

Note.—For more detailed information reference is made to the following Ordnance Department pamphlets:

No. 1888, Regulations for the care and test of smokeless powder, etc.

No. 1720, Regulations for the transportation of explosives, etc.

No. 1872, Seacoast artillery ammunition and instructions for its preparation, care, and use.

COMMERCIAL DETONATORS.

PACKAGE.

495. These detonators are supplied in pasteboard boxes containing 50 each, and the pasteboard boxes are shipped in suitable wooden containers.

STORAGE AND CARE.

496. Commercial detonators may be stored in any place which is available, provided it is cool, dry, secure from entrance by unauthorized persons, and not subjected to temperatures greater than 100° F.

497. Under no circumstances will detonators be stored with other explosives, except fuses and primers, and temporarily with dry guncotton when in the fuse cans preparatory to loading mines. (See Dry guncotton.)

498. On account of the sensitiveness of mercury fulminate, the filling charge of the detonator, to detonation, special care will be exercised in keeping individual detonators off the floor or other places where they may be exploded by stepping on them or dropping heavy articles on them.

499. Detonators will never be handled by the wires in such a way that the detonator itself may be brought in violent contact with any object.

INSPECTION.

500. The inspection of this class of explosives will be limited to seeing that the requirements of storage and care are observed strictly.

DYNAMITE.

PACKAGE.

501. Dynamite cartridges are packed ordinarily in sawdust in wooden boxes. Each cartridge is wrapped in paraffin paper. The cartridges are arranged in the box so that when they are transported all cartridges lie on their sides. Usually the amount of explosive in a single package does not exceed 50 pounds.

STORAGE AND CARE.

502. The boxes will never be allowed to stand so that the cartridges will be vertical.

503. Like other nitroglycerin mixtures, dynamite freezes at about 40° F., and in its frozen condition is, under ordinary circumstances, less liable to explosion from detonation or percussion than when thawed, but more susceptible to explosion by simple ignition. Should any of the nitroglycerin be exuded, the dynamite cartridges are much more sensitive to detonation by a blow.

504. It is important that dynamite cartridges be kept dry. If exposed to a moist atmosphere, there is a tendency for the water, condensed from the air on all exposed surfaces, to displace the nitroglycerin.

505. The cases will be raised from the floor on skids and the floor underneath covered with clean sawdust. The sawdust will be removed from time to time, the old sawdust being burned in the open air.

506. Rubber gloves will be worn in handling this explosive. In the absence of rubber gloves, the hands should be covered with grease, and cotton gloves should be worn. This is for the protection of the skin from the injurious effect of nitroglycerin.

507. Dynamite may be stored with wet guncotton (15 per cent water based on dry weight of explosive), Explosive D and trotol, but preferably should be stored by itself.

INSPECTION.

508. At the monthly inspection, all boxes will be examined to see if they are dry. If not dry, all will be exposed to the dry air out of the direct rays of the sun, but great care will be taken in handling these boxes to avoid dropping them or subjecting them to shock.

509. The principal source of danger from dynamite is in the exudation of the nitroglycerin. Exudation is indicated by the presence of small white, oily, lustrous globules of liquid, either among the particles of dynamite or on the packages. If such globules are discovered, they may be identified positively as nitroglycerin by absorbing a drop in a piece of unglazed paper, placing it on an anvil or other piece of metal, and striking it a sharp blow with a hammer. If it be nitroglycerin, a detonation will occur. Another test is to set fire to the paper, and if the liquid be nitroglycerin, it will burn with a crackling noise and a greenish-yellow flame.

510. If exuded nitroglycerin has stained floors or other material not readily destroyed, the nitroglycerin may be decomposed and rendered harmless by washing with sulphur solution. Sulphur solution may be made by boiling 50 pounds of lime in a barrel of water and adding powdered sulphur until the solution will take up no more. This requires about 20 pounds of sulphur. The resulting bright orange-colored solution is filtered and only the filtrate used. A suitable filter for this purpose is a piece of thin cheesecloth. Sodium carbonate may be used in the place of lime.

511. Dynamite may be destroyed by burning in small quantities at a time. The cartridges are slit with a knife and the contents are spread out over some straw or shavings and ignited carefully. If the dynamite is frozen it will not be burned.

EXPLOSIVE D.

PACKAGE.

512. This explosive is issued to the service for use in loading service projectiles. (See Ordnance Pamphlet 1721.)

513. Explosive D is at present contained in double paper bags containing about 100 to 125 pounds of explosive. These bags are inclosed either in the standard cartridge storage cases or in strongly hooped wooden barrels painted inside with ruberine or other authorized paint. That manufactured in future will probably be packed in boxes as described for trotol.

STORAGE AND CARE.

514. This explosive will be stored in a perfectly dry place, preferably in a magazine, as it has a slight tendency to absorb moisture. If it is impracticable to store in a magazine, the explosive may be stored in the driest place available where it is protected thoroughly from all fire risks.

515. The barrels will be stored on end, marked end uppermost.

516. No cards or other material will be tacked on the barrel.

517. No nails will be driven in the barrel.

518. If from any cause the barrels of explosive are wet and there is a reasonable assurance that the interior has become wet, a barrel will be selected and opened. If the interior is wet, a full report of the circumstances will be made to the War Department. If the interior is dry, the barrel will be reheaded carefully, and all barrels will be dried in the open air out of the direct rays of the sun.

519. Explosive D may be stored with wet guncotton (15 per cent water based on dry weight of explosive), dynamite, and trotol.

INSPECTION AT FORTS.

520. No technical inspection of this explosive will be made at forts except by the Ordnance Department. Inspection at forts will ordinarily be limited to seeing that the rules for storage and care are strictly observed.

521. Barrels will not be opened for the purpose of inspecting the contents, except as indicated above.

522. If any barrel shows signs of drying out or opening at the staves or head, all barrels will be given a coat of rubberine or other authorized paint.

FUSES AND PRIMERS.

PACKAGE.

523. Fuses and primers are packed in hermetically sealed metallic boxes, inclosed in suitable wooden containers. These boxes will not be opened until the fuses and primers are required for use.

STORAGE AND CARE.

524. Cases of fuses and primers may be stored in any place which is available, provided it is cool, dry, secure from entrance by unauthorized persons, and not subjected to a temperature greater than 100° F.

525. All boxes containing fuses will be marked with metal labels, obtained from the Ordnance Department, clearly indicating the projectiles to which the fuses are assigned.

526. Under no circumstances will fuses and primers be stored with other explosives except the commercial detonators used in submarine mines.

527. Fuses will not be disassembled for any purpose. Such action by inexperienced persons is liable to result in explosion.

INSPECTION.

528. The inspection of this class of explosives will be limited to seeing that the requirements of storage and care are observed strictly.

GUNCOTTON.

PACKAGE.

529. Wet guncotton for submarine mines is supplied in boxes containing approximately 100 pounds of dry guncotton with 25 pounds of water absorbed; total weight, 125 pounds. For storage this is dried down to 15 pounds of water to 100 pounds of dry guncotton. The boxes are lined with zinc and the lids are screwed down upon a rubber gasket. There is an opening in the lid for replacing water lost by evaporation. The manufacturer's name, date of nitration, and net and gross weights are stamped on each box. The object of having the gross weight on the box is to give an easy means of checking the amount of water contained in the guncotton at the time of the quarterly weighing.

STORAGE AND CARE.

530. Magazines in which guncotton is stored will not be allowed to attain a temperature as high as 100° F. for any length of time.

531. Guncotton which is *kept wet* may deteriorate after long storage, but will not become dangerous.

532. Wet guncotton can not be ignited by a flame, but gradually smoulders away as the outer portions in contact with the flame become dried.

533. A brownish or reddish shade is sometimes seen in cakes of guncotton. This may be due to the presence of iron in the wash water and does not necessarily indicate decomposition.

534. When storing guncotton in the magazine, the piles of boxes will be made so as to give free circulation of air and the greatest convenience in handling consistent with the capacity of the magazine.

535. In the event of damage to any case, which may cause loss of water by evaporation, the contents will be removed at once, repacked in a guncotton box which has been washed with soda solution, the proper amount of water added to the contents, and the box closed. The gross weight will be marked on the case. In repacking, the cakes will not be handled with the bare hands. This is for the protection of the guncotton from oil or acid of any kind. Clean cotton or rubber gloves are suitable covering for the hands when engaged on this work.

536. If for any reason the cases are subjected to dampness sufficient to cause unusual deterioration of the cases, they will be removed from the magazine and dried out of the direct rays of the sun.

537. Guncotton containing 15 per cent of moisture (percentage based on dry weight of explosive) may be stored with Explosive D, dynamite or trotol, but *never with dry guncotton.*

538. Empty cases, before being placed in storage, will be washed thoroughly to remove all traces of guncotton.

INSPECTION BY THE ORDNANCE DEPARTMENT.

539. Samples of each lot of guncotton issued to the service are preserved in the laboratory of the Ordnance Department for chemical test. These retained samples are subjected regularly to technical inspection and test by that department to determine their condition as to stability. This will insure the detection of lots that are deteriorating and their removal from the forts or their destruction, before they have deteriorated to such an extent that they become dangerous.

INSPECTION AT FORTS.

540. In addition to the regular monthly inspection, at the end of each quarter the officer responsible for submarine-mine explosive will supervise the weighing of each box of guncotton under his care. Any loss in the gross weight will be made up by the addition of distilled water poured through the filling hole. If there is no distilled water available, rain water should be used. Water thus added will be absorbed gradually by the charge.

No further inspection of this explosive is necessary.

DRY GUNCOTTON.

541. Dry guncotton is used for submarine mine primers.

542. Primers will not be prepared until just prior to the time they are to be used in loading. Therefore the period of storage will be short and no particular examination of the dry guncotton will be required.

543. Dry guncotton, during the interval between loading in the mine case and the time dryness is secured, will be stored ordinarily in an assembled fuse can. When prepared in this manner it will be kept in a cool, dry, and secure room away from all other explosives.

544. Dry guncotton will be handled as little as possible to prevent crumbling and scattering of guncotton dust. Finely divided guncotton is difficult to remove by brushing, and if allowed to collect about a room may give serious trouble by "flashing" should a portion become ignited. This dust may be removed with a damp sponge or cloth.

545. Dry guncotton which is not used as contemplated (par. 543) will be repacked with the proper amount of water.

TROTOL.

PACKAGE.

546. This explosive is trinitrotoluol. It is used in the service as an explosive charge for submarine mines, and is supplied in wooden boxes, doubly lined with waxed paper, each box containing about 50 pounds of explosive.

STORAGE AND CARE.

547. This explosive will be stored in a perfectly dry place, preferably in a magazine. If it is impracticable to store it in a magazine, the explosive will be stored in the driest place available where it is protected thoroughly from all fire risks.

548. The boxes will be stored in tiers with the marked ends out, the bottom tier resting on skids.

549. If from any cause the boxes of explosives are wet and there is reasonable assurance that the interior has become wet, a box will be selected and opened. If the interior is wet, a full report on the circumstances will be made to the War Department. The boxes will be opened and the contents dried in open air, out of the direct rays of the sun.

550. Trotol may be stored with wet guncotton (15 per cent water based on dry weight of the explosive), explosive D, and dynamite.

INSPECTION.

551. Inspection at forts will be limited to seeing that the rules for storage and care are strictly observed.

552. Technical inspections will be made when required by the Ordnance Department.

SMOKELESS POWDER.

PACKAGE.

553. Powder charges are now supplied to forts in hermetically sealed cases and will be opened only in accordance with War Department instructions.

STORAGE AND CARE.

554. Smokeless powder will be stored in the driest available magazines. So long as the container remains sealed, the only effect of water is to cause unusual deterioration of the case.

555. No magazine in which the temperature of the air rises above 95° F. will be used for the storage of smokeless powder.

556. Powder storage cases containing propelling charges will normally be piled on end with skids under the first tier and each succeeding tier. This arrangement may be departed from in case special facilities for piling the cases in some other manner are provided, or in case the length of the storage case is so great relative to the diameter that there is danger of tiers falling down. If cases are piled on the side for any reason, particular care should be taken to separate them by skids rounded out to fit the contour of the case, as experience has shown that the piling of cases on their sides, either without skids or with ordinary skids, has a tendency to break the seals of the cases, causing them to leak.

557. Notwithstanding the great care taken in sealing storage cases it is almost impossible to prevent some slight escape of volatiles, therefore a slight odor of ether in a magazine does not indicate deterioration. However, if the ether odor is persistently strong it indicates a leaky storage case, which will be found by a process of elimination.

558. Testing sets are issued to each coast defense command for use in testing containers intended to be kept sealed air-tight. When a leaky case is found or the seal of a storage case of powder discovered to have been accidentally broken, the container will be securely resealed without delay, unless the container is badly damaged, the powder believed to have been wet, or there are other unusual circumstances, in which case report will be made to the armament officer.

INSPECTION BY THE ORDNANCE DEPARTMENT.

559. Samples of each lot of smokeless powder issued to the service are preserved in the laboratory of the Ordnance Department for chemical test. These retained samples are subjected regularly to technical inspection and test by that department to determine their condition as to stability. Should any lot show deterioration, the change is discovered by such inspection, and the entire lot recalled from forts where it is stored.

INSPECTION AT FORTS.

560. With each lot of powder supplied to a fort there is furnished a ground glass stoppered bottle containing a sample of the particular lot of powder. This bottle will be stored in the magazine with the corresponding lot of powder. The object of preserving this sample bottle in the magazine is to enable the responsible officer to keep his powder under regular observation.

561. A strip of dry tenth normal methyl violet paper will be kept in each sample bottle at all times. The paper gradually loses its color in the presence of oxides of nitrogen as given off by decomposing smokeless powder. The time of test is the number of days required for the paper to lose all color and become entirely white.

562. A fresh strip of test paper will be inserted in the bottle every 30 days and will have entered on it in pencil the date when inserted. If desired, old strips may be left in the bottle for 30 extra days. All strips will be examined from time to time to detect change of color. The examination will be made without removing the stopper except when the test paper is to be inserted or removed. The bottle will never be left open longer than is absolutely necessary, since the absorption of moisture and loss of volatiles due to exposure to the atmosphere affect the powder, while the escape of nitrous fumes that may have formed in the bottle, delays the completion of the test. A perfectly stable powder will give a test of 60 days or more, but a test of 30 days indicates that the stability is reasonably satisfactory. If any sample causes the paper to turn completely white in 30 days or less, a report will be submitted by the coast defense commander, giving the data indicated on the blank form provided for that purpose.

563. Methyl violet paper is not affected by diffused light or ordinary handling, but will not be exposed to direct sunlight nor soiled by careless handling. Care will be taken not to handle the sample powder grains with moist fingers or to otherwise contaminate them.

564. Twice annually (about January 1 and July 1) a fresh sample will be taken from one of the charges of each lot of powder on hand, except that in fixed ammunition. When especially unfavorable results are being obtained, the samples of powder giving poor results will be changed every three months. The fresh sample will be as nearly as practicable of the same weight or number of grains as the one previously used. A sample that has been in use for test purposes will not be added to the charge from which the fresh sample is taken, but will be destroyed. No more than one sample will be taken from any one charge, and a charge from which a sample has been taken will be marked so as to insure this. The necessary powder for replacing samples taken from charges will be obtained on requisition by coast defense ordnance officers, and the containers of the powder received for this purpose will be marked so as to be readily identified. A certain percentage of the powder charges assembled hereafter will have small bags containing powder for test purposes packed in the cartridge-storage cases. The inside of the glass bottles for holding samples will be carefully washed and dried before adding a fresh sample of powder. Distilled water will be used when practicable, otherwise the purest water available. The drying will be done by the application of heat and not by wiping with a cloth.

565. Fresh samples will be taken from the charges or the bags containing samples removed and the storage cases resealed under direction of the coast defense ordnance officer.

566. A round of fixed ammunition representing each lot of powder will be disassembled annually about January 1, for the purpose of obtaining a fresh sample, and then reassembled. A set of fixtures required for this work will be kept on hand by each coast defense ordnance officer. Care will be exercised to replace the sample by an equal weight of suitable powder, and before reassembling fixed ammunition the material furnished for the purpose will be applied to the projectile in rear of the band to insure an air-tight joint.

567. Powder-storage cases.—Whenever it may be necessary to delay using the powder in cases which have been opened, the following method of resealing cases temporarily is prescribed for the proper protection of the smokeless-powder charges:

568. Support the powder-storage case in a horizontal position on a table or bench, and after pressing the lid firmly on the case apply melted paraffin with a brush to the joint between the lid and the case, at the same time turning the latter rather rapidly at first, but more slowly as the paraffin sets. Each layer should be allowed to set before applying the next one. Before putting on the lid the joint between it and the case should be made clean and dry. Detailed instructions are contained in Ordnance pamphlet 1872.

PROJECTILES, FILLED AND FUSED.

(See pars. 461 and 463.)

STORAGE AND CARE.

569. These projectiles will be stored in the magazines provided for them, piled, and painted as required by existing orders.

570. They will be kept dry as possible and free from rust.

571. While premature explosions are not expected, projectiles filled and fused will be handled with great care.

INSPECTION.

572. On account of the nature of the envelope, no inspection of the explosive is possible. The inspection of the projectiles will be limited to seeing that the requirements of "Storage and care" are observed strictly.

PROJECTILES FILLED BUT NOT FUSED.

573. The fuse-hole plugs should be set up fairly tight to exclude moisture. Fuse seats should not be formed unless it is actually intended to insert fuses. No danger from handling is to be expected, but care will be taken. The necessary fuses, base covers, etc., required to complete their preparation for service should be on hand at all times in boxes properly marked for identification.

INSPECTION.

574. As prescribed for projectiles, filled and fused.

FIXED AMMUNITION.

STORAGE AND CARE.

575. Fixed ammunition for small arms or for cannon will preferably not be stored in the same magazine with other explosives. If the magazine is damp, the boxes will be piled on skids with strips between tiers and a space between boxes in a tier to permit the free circulation of air around the boxes.

INSPECTION.

576. The inspection at forts will be limited to seeing that the requirements for its storage and care are observed strictly.

Chapter XXVI.

DEFINITIONS.

NOTE.—In this chapter will be found definitions of terms not found elsewhere in the book. To find any particular term see the index.

577. **Aiming.**—See Pointing.

578. **Ammunition.**—A general term applied to projectiles, explosives used for propelling projectiles, explosives used for filling projectiles, primers used for discharging guns and mortars, and fuses used for exploding projectiles. When the projectile, propelling charge, and primer are held permanently together by a metallic case inclosing the powder and primer, or otherwise, in condition to be handled as a unit in loading, the ammunition is called "fixed ammunition." When the projectile, propelling charge, and primer are not so held together, but are handled separately in loading, the ammunition is called "separate-loading ammunition."

579. **Ammunition truck.**—A truck for carrying projectiles to the breech of cannon.

580. **Angle danger.**—See Danger angle.

581. **Angle of departure.**—The angular elevation of the line of departure above the line of sight. Quadrant angle of departure is the angular elevation of the line of departure above the horizontal plane through the muzzle of the gun in the firing position. (See fig. 15, par. 790.)

582. **Angle of depression.**—The angular depression of the line of sight below the horizontal plane. (See fig. 15, par. 790.)

583. **Angle of fall.**—The angle between the line of fall and the horizontal plane through the muzzle of the gun in the firing position. It is often represented by its slope; for example, 1 on 10. (See fig. 15, par. 790.)

584. **Angle of impact.**—The angle between the line of impact and the tangent to the surface at the point of impact. It is the complement of the angle of incidence. (See fig. 15, par. 790.)

585. **Angle of incidence.**—The angle between the line of impact and the normal to the surface at the point of impact. (See fig. 15, par. 790.)

586. **Angle of jump.**—The angular elevation of the line of departure above the position of the axis of the bore at the time the piece was pointed. In determining the sight or quadrant elevation to be used, this angle must be subtracted algebraically from the angle

of departure given in the range table; the angle of jump differs for different guns, carriages, and ranges, and is determined by experiment.

587. **Angle of splash.**—See Danger angle.

588. **Apron.**—That portion of the superior slope of a parapet or the interior slope of a pit designed to protect the slopes against blast.

589. **Axis of cannon or axis of bore.**—The central line of the bore.

590. **Axis of trunnions.**—The central line of the trunnions.

591. **Azimuth (of a point).**—In coast artillery usage, the horizontal angle measured in a clockwise direction from the south line through the observer's position to the line from the observer to the point. For example, the azimuth of a point B from A is the angle (measured clockwise from the south) between the north and south line through A and the line from A to B. The north point has an azimuth of 180°.

592. **Azimuth difference.**—The difference between two azimuths of a point as read from two other points, as, for example, the difference in azimuths of a target as read from the primary station and from the directing point of the battery.

593. **Ballistics.**—That branch of the science of gunnery which treats of the motion of projectiles. Interior ballastics treats of the motion within the gun. Exterior ballastics treats of the motion outside of the gun.

594. **Base line.**—A horizontal line the length and direction of which have been determined. This line is used in position finding, especially for long ranges; the stations at its ends are called "observing stations." It is called "right-handed" or "left-handed," depending on whether the secondary station is to the right or left of the primary from the point of view of a person facing the field of fire. The base end observing stations are called primary, secondary, or supplementary.

595. **Base ring.**—The metal ring which is bolted to the concrete of the emplacement and which supports the weight of the gun or mortar carriage.

596. **Battery.**—One or more guns or mortars grouped with the object of concentrating their fire on a single target and of being commanded directly by a single individual, together with the entire structure erected for their emplacement, protection, and service.

597. **Battery parade.**—The area in rear of the emplacements where the gun or pit sections form.

598. **Battle area.**—As applied to a coast defense or a fort command, the area covered by the armament of the coast defense or the fort command, respectively.

599. **Battle chart.**—A chart used in fort, fire, or mine command stations, showing the water area covered by the armament of their respective commands.

600. **Blending.**—The process of mixing powders of the same or different lots so as to obtain charges of uniform characteristics.

601. **Bore.**—The interior of a cannon forward of the front face of the breechblock. It is composed of the gas check seat, the powder chamber, the centering slope, the forcing slope, and the rifled portion called the "main bore." The *length of bore* is the distance from the front face of the breechblock proper (not the mushroom head) when in position to the face of the muzzle measured along the axis of the bore.

602. **Breech.**—The mass of metal behind the plane of the rear section of the bore of a cannon, the section being taken at right angles to the axis of the bore.

603. **Breechblock.**—The metal plug which closes the breech of a cannon.

604. **Breech bushing.**—That part of the breech on the interior surface of which the threaded and slotted sectors of the breech recess are formed.

605. **Breech, face of.**—The rear plane of a cannon perpendicular to the axis of the bore.

606. **Breech mechanism.**—The breechblock, obturating device, firing mechanism, and all parts used in operating the breechblock of a cannon.

607. **Breech recess.**—The opening in a cannon which receives the breechblock.

608. **Breech reinforce.**—The part of a cannon in front of the breech and in rear of the trunnion band.

609. **Caliber.**—The diameter of the bore in inches, measured between diametrically opposite lands. It is the minimum diameter of the rifled portion of the cannon.

610. **Cannon.**—Artillery weapons from which projectiles are thrown by the force of expanding powder gases. (See Gun or piece.)

Cannon are of three classes: Guns, mortars, and howitzers.

Guns are long (generally 30–50 calibers), have flat trajectories, and are used for direct fire (not exceeding 20°), with high velocities.

Mortars are short (about 10 calibers), and are used for high-angle fire (above 45°), with low velocities.

Howitzers are short guns and are used for curved fire (not exceeding 45°), with low velocities.

Cannon of the United States land service are classified according to their use into coast, siege, field, and mountain.

Built-up cannon are made by shrinking forgings (jacket and hoops) over an inner tube. Wire-wound cannon are made by winding wire under tension around a tube; a jacket and hoops may be shrunk over the wire-wound tube.

611. **Cannoneer.**—Any man employed in the "service of the piece."

612. **Capital.**—As applied to an emplacement—the line through the pintle center bisecting the arc of the interior crest. As applied to a battery—the perpendicular to the line of pintle centers at its middle point.

613. **Cap-square.**—That part of a gun or mortar carriage which fits over the trunnion and holds the trunnion in the trunnion bed.

614. **Carriage or mount.**—The means provided for supporting a cannon. It includes the parts for giving elevation and direction, for taking up the recoil on discharge, and for returning the piece to the firing position.

615. **Carriage, fixed.**—A mount provided for guns *and* mortars in permanent works and not designed to be moved from place to place.

616. **Carriage, movable (wheeled mount).**—A carriage or mount provided with wheels for transportation of the piece mounted thereon.

617. **Carriages, seacoast.**—Those used for coast artillery cannon. They may be divided into four classes, depending upon the nature of cover afforded by the emplacements.

(*a*) **Barbette**: Where the gun remains above the parapet for loading and firing. Barbette carriages are used for guns of 3-inch or greater caliber. The pedestal mount is a type of barbette carriage used for guns up to 6 inches in caliber.

(*b*) **Disappearing**: Where the gun is raised above the parapet for firing and recoils under cover for loading. This mount is used for guns of 6-inch or greater caliber.

(*c*) **Masking parapet mount.**—Where the gun remains above the parapet for loading and firing but can be lowered below the level of the crest for concealment. This mount is also called the balanced pillar mount and is used for guns up to 5 inches in caliber.

(*d*) **Casemate.**—Where the gun fires through a port.

618. **Cartridge.**—A complete load of fixed ammunition (projectile, powder, and primer) as used in small arms.

619. **Cartridge bags.**—Bags used to hold the powder charges for cannon.

620. **Cartridge case.**—A container in which powder is sealed for shipment and storage.

621. **Case I, Case II, Case III.**—See Pointing.

622. **Centering slope.**—The conical part of the bore between the powder chamber and the forcing slope. It is for the purpose of bringing the axis of the projectile in line with the axis of the bore.

623. **Center of impact.**—The mean position of the points of impact of the points of splash considered.

624. **Center of the target.**—As used in coast artillery practice, the point from which deviations are measured. (See Deviation).

625. **Center, pintle.**—See Pintle center.

626. **Charge.**—The explosive placed in a gun or mortar behind the projectile as a propellant (propelling charge). Also the explosive placed in the cavity of a projectile (bursting charge).

627. **Charge (or powder) section.**—One of the component parts of a charge when the charge is made up of two or more separate parts.

628. **Chase.**—That part of a cannon in front of the trunnion band.

629. **Chassis.**—That part of a gun carriage upon which the top carriage moves backward and forward. The chassis carries recoil rollers and the top carriage rests upon these rollers.

630. **Chord of the trajectory.**—The straight line joining the extremities of the trajectory, i. e., the straight line from the muzzle of the gun (in the firing position) to the point of splash. (See fig. 15, par. 790.)

631. **Clinometer.**—An instrument for measuring vertical angles with great accuracy; for example, the inclination of the axis of the bore to the horizontal.

632. **Clinometer rest.**—A device inserted in the muzzle of a gun for the purpose of supporting a clinometer; also called "bore plug" or "bore rest."

633. **Coast artillery militia.**—Troops of the organized militia organized as coast artillery for the purpose of supplementing the regular coast artillery in time of war.

634. **Coast artillery supports.**—Troops of the mobile army assigned to coast artillery forts to repel land or landing attacks in the immediate vicinity of the fortifications.

635. **Corridor.**—The uncovered passageway in rear of a traverse connecting two adjacent emplacements.

636. **Corridor wall.**—The traverse wall along the corridor.

637. **Counter-recoil buffers.**—Devices on gun and mortar carriages for the purpose of reducing the shock due to the return of the piece to the firing position.

638. **Counterweight.**—The weight used in bringing a gun on a disappearing carriage to the firing position. The pit in the gun platform for the reception of the counterweight is called the counterweight well.

639. **Crow's nest.**—A recess on a parapet or traverse, used as an observing station.

640. **Danger angle.**—(Also called angle of splash). The angle which the tangent to the trajectory at the point of splash makes with the plane containing the point of splash and parallel to the horizontal plane through the muzzle of the piece in the firing position. (See fig. 15, par. 790.)

641. **Danger space.**—The horizontal distance within which a target of a given height would be hit by a projectile. The danger space varies with the range, the flatness of the trajectory, the height of the target, and the height of the gun above the target.

The maximum range which is all danger space is called the "danger range."

642. **Data line.**—A telephone line used for the transmission of data. (See Intelligence line.)

643. **Datum point.**—A fixed point, the azimuth and range of which, from one or more observing stations, have been accurately determined.

644. **Deflection.**—The angle between the plane of sight and plane of departure; it is usually expressed as a reference number, and is set off on the sight deflection scale.

645. **Delivery table.**—The hoist table from which the projectiles are delivered to the trucks.

646. Density of loading.—The mean density of the whole contents of the powder chamber. It is the ratio of the weight of the powder charge to the weight of a volume of distilled water at the temperature of maximum density (39.2° F.) which will fill the powder chamber. The formula for computing it is—

$$\Delta \text{ (density of loading)} = 27.68\ \varpi / V$$

in which ϖ is equal to the weight of the powder in pounds and V the volume of the chamber in cubic inches.

647. Deviation.—As used in coast artillery practice, deviations are either the horizontal distances of the points of splash from the center of the target, or the rectilinear coordinates of those distances. Deviations are measured in a plane passing through the water line of the target and parallel to the horizontal plane through the muzzle of the piece in the firing position.

(*a*) **Absolute deviation.**—The shortest distance between the center of the target and the point of splash.

(*b*) **Lateral deviation.**—The distance between the plane of direction and the plane of splash measured (right or left) from the center of the target and perpendicular to the plane of direction.

(*c*) **Longitudinal deviation.**—The perpendicular distance (over or short) of the point of splash from the vertical plane passing through the center of the target and perpendicular to the plane of direction.

(*d*) **Mean lateral deviation.**—The algebraic mean of the lateral deviations of a series of shots.

(*e*) **Mean longitudinal deviation.**—The algebraic mean of the longitudinal deviations of a series of shots.

(*f*) **Mean absolute deviation.**—The algebraic mean of the absolute deviations of a series of shots.

(*g*) **Range deviation.**—The difference between the range to the target (at the instant the projectile strikes) and the range to the point of splash. The range deviation is equal to the longitudinal deviation when the lateral deviation is zero.

648. Deviation, azimuth.—The difference between the azimuths from the directing point of the battery to the center of the target and to the point of splash at the instant the projectile strikes.

649. Difference chart.—A graphic device by means of which the range and azimuth of a target from one gun or station are obtained when the range and azimuth from some other gun or station are known.

650. Directing point.—A point at or near the battery for which relocation is made at the plotting room. It is the point for which the gun center of the plotting board is adjusted. When the pintle center of a gun is taken as the directing point, such gun is called the "directing gun."

651. Drift.—The divergence of the projectile from the plane of departure due to the rotation of the projectile and the resistance of the air. It is affected by the ballistic character of the projectile. It is in the direction of rotation and for the United States service rifled guns it is to the right. It may be expressed either in yards or degrees.

652. Electrician sergeant.—An enlisted specialist of the noncommissioned staff coast artillery corps who is assigned to duty in connection with the electrical installations of coast artillery forts.

653. Elevating band.—A band around a gun near the breech to which are attached the elevating arms. By means of the elevating gearing, the elevating arms give elevation to the gun.

654. Elevation.—The inclination in a vertical plane given to the axis of the bore in pointing a gun; the angular elevation of the axis of the bore above the line of sight is the sight elevation; the angular elevation of the axis of the bore above the horizontal is the quadrant elevation.

655. Elevation table.—A table of ranges with corresponding *quadrant elevations* for a direct-fire gun on a mount provided with an elevation device graduated in ranges. The quadrant elevations tabulated in the elevation table are the angles of departure of the range table corrected for curvature of earth, height of sight, and jump.

656. Emplacement.—That part of the battery pertaining to the position, protection, and service of one gun, mortar, or group of mortars.

657. Emplacement book.—A book containing all necessary data concerning the battery.

658. Energy of the projectile.—The energy stored up in the projectile by the force of the expanding gases generated by the explosion of the powder charge. It is expressed usually in foot-tons. The formula for computing it is—

$$E = WV^2 / (4480g),$$

in which W is the weight of the projectile in pounds, V its velocity in feet per second, and g the acceleration due to gravity (mean value 32.16). V may be taken as the velocity at any instant and the energy remaining at that instant can be determined from the formula.

659. Engineer.—An enlisted specialist of the noncommissioned staff Coast Artillery Corps who, under the artillery engineer, is placed in charge of one or more power plants at a coast artillery fort.

660. Enlisted specialists.—Noncommissioned staff officers of the Coast Artillery Corps who are assigned to technical duties at coast artillery forts. The various grades are master electrician, engineer, electrician sergeant first class, electrician sergeant second class, master gunner, and fireman.

661. Equalizing pipe.—A pipe connecting the front ends of two recoil cylinders for the purpose of equalizing the pressure therein.

662. Erosion.—The gradual enlargement and scoring of the bore due to the action of powder gases on the metal of the lands and grooves.

663. **Error.**—As used in coast artillery practice, errors are either the horizontal distances of the points of splash from the center of impact, or the rectilinear coordinates of those distances. Errors are measured in a plane passing through the center of impact and parallel to the horizontal plane through the muzzle of the piece in the firing position.

(*a*) **Absolute error.**—The shortest distance between the center of impact and the point of splash.

(*b*) **Lateral error.**—The distance between the plane of splash and a plane through the center of impact parallel to the plane of direction, measured (right or left) from the center of impact and perpendicular to the plane of direction.

(*c*) **Longitudinal error.**—The perpendicular distance (over or short) of the point of splash from a vertical plane passing through the center of impact and perpendicular to the plane of direction.

(*d*) **Mean absolute error.**—The arithmetical mean of the absolute error of a series of shots.

(*e*) **Mean lateral error.**—The arithmetical mean of the lateral errors of a series of shots.

(*f*) **Mean longitudinal error.**—The arithmetrical mean of the longitudinal errors of a series of shots.

664. **Error, probable.**—The probable error of a gun in any direction is that error which is as likely to be exceeded as not in the case of any single shot of a series fired with the same elevation and azimuth settings. This is equivalent to saying that in the long run 50 per cent of all shots fired with the same elevation and azimuth settings will have an error less than the probable error.

665. **Explosive.**—Any substance by whose decomposition or combustion, gas is generated with great rapidity. Military explosives consist of solids or liquids which, through the application of heat or shock, are susceptible of being converted suddenly into gases through chemical reactions.

666. **Exterior crest.**—The line of intersection of the superior and exterior slopes.

667. **Exterior slope.**—The outer slope of the battery.

668. **Field of fire.**—The area covered by the armament of a battery, or with reference to a single gun, it is the area covered by that gun.

669. **Fire area.**—The area covered by the armament of a fire command.

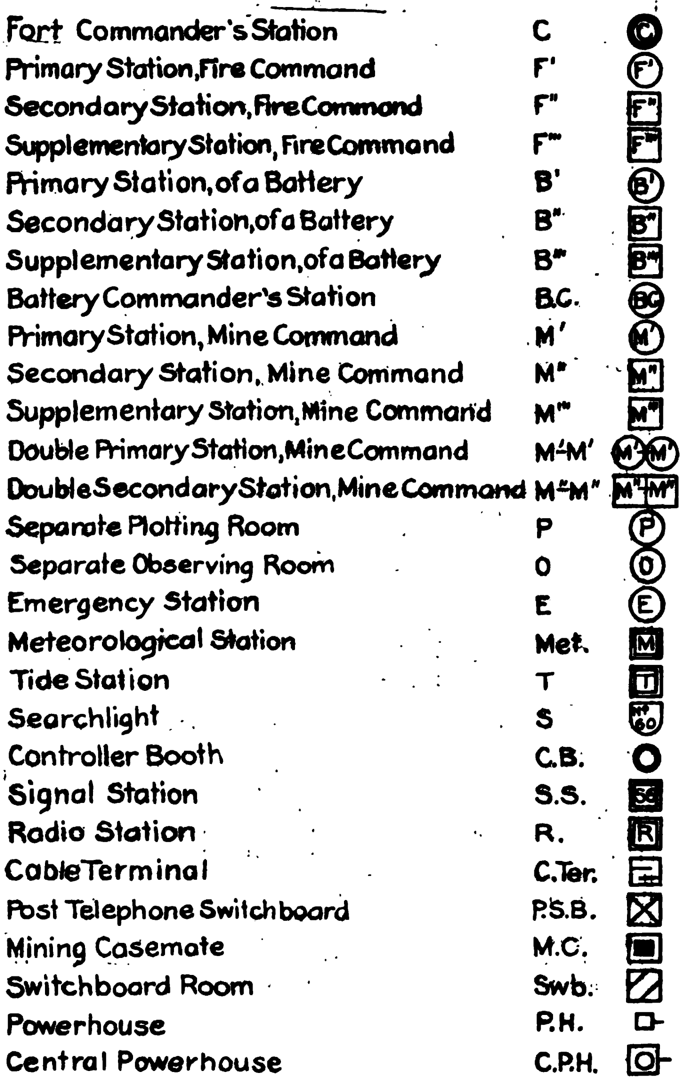
670. **Fire control.**—Fire control is the exercise of those tactical functions connected with the concentration and distribution of fire, including the assignment and identification of targets.

671. **Fire control diagram.**—A diagram showing the assignment of batteries to fire or mine commands, the division of fort commands into fire and mine commands, the assignment of searchlights, and the system of communications for the tactical chain of command in any particular coast defense command.

672. **Fire control installation.**—The matériel as installed, which is employed in the fire control or fire direction of any unit, is called the "fire-control installation" for that unit.

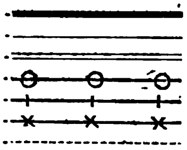
673. **Fire control symbols.**—The following symbols are used in fire-control diagrams and for other purposes:

Fig. 13.



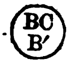
Fort Commander's Station	C
Primary Station, Fire Command	F'
Secondary Station, Fire Command	F"
Supplementary Station, Fire Command	F'''
Primary Station, of a Battery	B'
Secondary Station, of a Battery	B"
Supplementary Station, of a Battery	B'''
Battery Commander's Station	B.C.
Primary Station, Mine Command	M'
Secondary Station, Mine Command	M"
Supplementary Station, Mine Command	M'''
Double Primary Station, Mine Command	M'-M'
Double Secondary Station, Mine Command	M"-M"
Separate Plotting Room	P
Separate Observing Room	O
Emergency Station	E
Meteorological Station	Met.
Tide Station	T
Searchlight	S
Controller Booth	C.B.
Signal Station	S.S.
Radio Station	R.
Cable Terminal	C.Ter.
Post Telephone Switchboard	P.S.B.
Mining Casemate	M.C.
Switchboard Room	Swb.
Powerhouse	P.H.
Central Powerhouse	C.P.H.

Base line
Telephone line (single)
Telephone line (double)
Speaking tube
Mechanical range transmission
Electrical range transmission
Searchlight controller

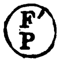


In general, where stations are combined in one room the letters representing each station will be inclosed in the symbol, for example:

B. C. station and primary combined



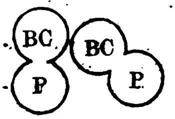
Primary station of a fire command and plotting room combined



Where stations are located in contact so that communication may be had by voice through a passage, door, window, or voice tube, the symbols for such stations will be tangent to each other, the circles will be left open at the point of contact, and will be so placed as to indicate the relative locations of the stations, for example:

B. C. stations

Plotting rooms



674. Fire direction.—Fire direction is the application of the methods and training necessary to secure accuracy of fire. A battery commander exercises fire direction while the fire commander exercises fire control.

675. Fire discipline.—The efficiency of personnel in action, involving accuracy and alertness resulting from organization, drill, and combined practice. It is measured by the length of time required to exercise fire control and fire direction; the time required to assign targets and to fire accurately.

676. Fire, kinds of:

(*a*) **Direct fire.**—Fire with high velocities and with angles of elevation not exceeding 20°.

(*b*) **Curved fire.**—Fire with low velocities and with angles of elevation not exceeding 45°.

(*c*) **High angle fire.**—Fire with low velocities and with angles of elevation above 45°.

677. Fireman.—An enlisted specialist of the noncommissioned staff Coast Artillery Corps, who under the engineer is assigned to duty for firing boilers, running engines, and other work in a power plant at a coast artillery fort.

678. Forcing slope.—The part of the bore immediately in front of the centering slope. The rifling begins at the junction of the centering slope and the forcing slope. The tops of the lands at this point are cut down so that less power is required at first to force them through the copper rotating band. The lands attain their full height at the front end of the forcing slope.

679. **Fort record book.**—A permanent record book kept at each fort, containing the history of the works, their object, armament, scheme of defense, and all information of value regarding the equipment and installation.

680. **From battery.**—The position of a gun when withdrawn from its firing position.

681. **Fuse.**—A device attached to a projectile for the purpose of causing the explosion of the bursting charge either by impact or at the expiration of a certain time of flight. Fuses are classified according to construction, as ring resistance, combination, time, and percussion, centrifugal, and detonating; they are classified according to location in the projectile as point and base.

682. **Gallery.**—Any passageway covered overhead and at the sides.

683. **Gas check seat.**—That part of the bore of a cannon where the gas check pad rests when the breechblock is closed.

684. **Gun or piece.**—A general term applied to any firearm from which a missile is propelled by the force of expanding gas. In a a restricted sense, the term "gun" is applied as defined under "Cannon."

685. **Gun levers.**—Two steel arms on a disappearing carriage which support the gun at one end and the counterweight at the other end. The gun trunnions rest in trunnion beds on the gun levers, and the counterweight is suspended from a steel crosshead which joins the ends of the gun levers. The gun levers are pivoted near their middle upon a gun-lever axle which rests in bronze bushed axle beds in the top carriage.

686. **Gunnery.**—The art and science of operating guns.

687. **Gun platform.**—That part of the battery upon which the gun carriage rests.

688. **Harbor chart.**—A chart showing the water area included in and adjacent to a fortified harbor.

689. **Height of site.**—The altitude of the axis of the gun trunnions in the firing position above the plane of mean low water. (See fig. 15, par. 790.)

690. **Hoist room.**—The room in a battery containing the receiving table of the ammunition hoist.

691. **Hoop.**—A forging superposed upon the jacket, tube, or other hoops of a cannon.

692. **In battery.**—The position of a gun when ready for firing.

693. **Intelligence line.**—A telephone line used for the transmission of orders and messages as distinguished from data. If practicable, a data line should never be used for anything except data.

694. **Interior crest.**—The line of intersection of the interior slope with the superior slope. If there be no interior slope, it is the line of intersection of the interior wall and superior slope.

695. **Interior slope.**—The inner slope of a parapet connecting the interior wall and superior slope.

696. **Interior wall.**—The inner parapet wall.

697. **Jacket.**—The principal forging shrunk on the breech end of a tube of a cannon.

698. **Jump.**—See Angle of jump.

699. **Landward defenses.**—Those portions of the defenses which are provided to repel an attack from the land area in rear of or on the flank of permanent seacoast works.

700. **Line of departure.**—The direction of the axis of the bore when the projectile leaves the muzzle of the gun. (See fig. 15, par. 790.)

701. **Line of direction.**—The straight line from the muzzle of the gun (in the firing position) to the center of the target at the instant the shot strikes. (See fig. 15, par. 790.)

702. **Line of fall.**—The tangent to the trajectory at the point of fall. (See fig. 15, par. 790.)

703. **Line of impact.**—The tangent to the trajectory at the point of impact. (See fig. 15, par. 790.)

704. **Line of sight.**—The axis of collimation of the telescope or the straight line passing through the sights of the piece; at the instant of firing this line passes through the center of the target.

705. **Load.**—A single charge of powder and a single projectile as combined for firing in a gun or mortar.

706. **Loading platform.**—That surface upon which the cannoneers stand while loading the piece.

707. **Loading tray.**—A device used to protect the breech recess while loading the projectile.

708. **Lot.**—A term used by manufacturers to designate a certain amount of explosive manufactured at one time. All of the explosive of one lot should possess uniform characteristics.

709. **Machine guns.**—Guns of one or more barrels using fixed ammunition and provided with mechanism for continuous loading and firing. The mechanism may be operated by man power or by the force of recoil.

Guns in which the force of recoil is used to operate the breechblock are termed "semiautomatic." When this force is used also to load and fire the guns, they are termed "automatic."

710. **Magazine.**—A room for storage of powder, primers, or fuses, etc.

711. **Maneuvering ring.**—A large cast-iron ring embedded in the emplacement wall, and used in mechanical maneuvers.

712. **Master electrician.**—An enlisted specialist of the noncommissioned staff Coast Artillery Corps who is assigned to duty as assistant to the artillery engineer in connection with the electrical and power installations of a coast defense command.

713. **Master gunner.**—An enlisted specialist of the noncommissioned staff Coast Artillery Corps who is assigned to duty as assistant to the artillery engineer in connection with the preparation of charts, maps, drawings, range tables, etc., in a coast defense command.

714. **Mushroom head.**—The front part of the De Bange obturator.

715. **Muzzle.**—The front end of a cannon. The face of the muzzle is the front plane of the gun perpendicular to the axis of the bore.

716. **Muzzle or initial velocity.**—The rate of travel in feet per second at which a projectile leaves the muzzle of a gun.

717. **Obturator.**—A device for preventing the escape of gas. Obturation is the process of preventing the escape of gas.

718. **Parade slope.**—The rear slope or wall of an emplacement.

719. **Parados.**—A structure in rear of a battery for protection against fire from the rear. It may have interior, superior, and exterior slopes.

720. **Parapet.**—That part of a battery which gives protection to the armament and personnel from front fire.

721. **Penetration.**—This term used with reference to a projectile fired against armor signifies that the point of the projectile entered the armor but the projectile did not get all the way through.

722. **Perforation.**—This term used with reference to a projectile fired against armor signifies that the projectile passed entirely through the armor.

723. **Piece.**—See Gun or piece.

724. **Pintle center.**—The vertical axis about which a gun or mortar carriage traverses.

725. **Pit.**—That part of a mortar emplacement designated for mounting one or more mortars, usually two or four.

726. **Plane of departure (also called plane of fire).**—The vertical plane containing the line of departure.

727. **Plane of direction.**—The vertical plane containing the line of direction.

728. **Plane of sight.**—The vertical plane containing the line of sight.

729. **Plane of splash.**—The vertical plane containing the chord of the trajectory.

730. **Point of fall.**—The point at which the trajectory again pierces the horizontal plane through the muzzle of the gun. (See fig. 15, par. 790.)

731. **Point of impact.**—The point at which the projectile first strikes. When the projectile strikes the water before striking any object, the point of impact and the point of splash are the same. (See fig. 15, par. 790.)

732. **Point of splash.**—The point at which the trajectory pierces the surface of the water. (See fig. 15, par. 790.)

733. **Pointing.**—The operation of giving the direction and elevation necessary to hit the target. When the sight is used it is called "aiming"; when the sight is not used it is called "laying."

There are three cases of pointing:

Case I. When direction and elevation are both given by the sight.

Case II. When direction is given by the sight and elevation by the range scale on the carriage or by quadrant.

Case III. When direction is given by the azimuth scale and elevation by quadrant or by the range scale on the carriage.

734. **Position finder.**—An instrument for locating a target.

735. **Position finding system.**—The term applied to the system used in determining the range and direction to any target from a battery or station.

736. **Powder chamber.**—The portion of the bore for the reception of the powder charge. It is between the breech recess and the centering slope.

737. **Predicted point.**—The point at which it is estimated a target will arrive at the end of an assumed interval of time reckoned

from the time of the last observation on which the estimate is based. This interval of time is called the "predicting interval."

738. **Predictor.**—An accessory of the plotting board used to locate the positions of the predicted and the set-forward points on the plotting board.

739. **Pressure gauge.**—A gauge placed in cannon to measure the maximum pressure developed during firing.

740. **Primer.**—The device used for igniting the propelling charge. Primers may be friction, percussion, electric, or combination (electric and friction).

741. **Priming charge or igniter.**—Small charges of black powder in the ends of powder sections necessary for the ignition of smokeless powder.

742. **Projectile.**—The term applied to a missile thrown from a firearm by an explosive. The principal parts of an armor-piercing projectile are the ballistic cap, the armor-piercing cap, the nose or point, the ogive, the bourrelet, the body, the rotating band, the cavity, the base, the base plug, and the fuse plug, as shown in the accompanying diagram.

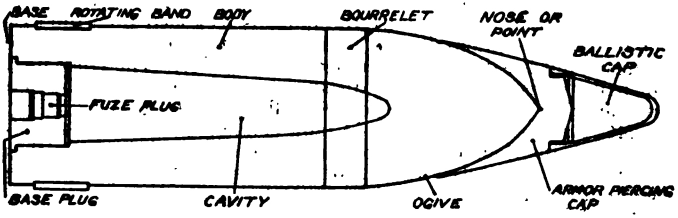


FIG. 14.

The ballistic cap is for the purpose of reducing the effect of or the retardation due to the resistance of the air. It consists of a hollow metal cap placed over the armor-piercing cap.

The armor-piercing cap is a piece of soft steel placed over the point to prevent the point from bending or breaking on impact against hard-faced armor, and to thereby increase penetration.

The lower part of the ogive is turned off to make a cylindrical bearing surface for the front part of the projectile. This surface, called the bourrelet, has a diameter slightly less than the caliber of the gun, but greater than that of the cylindrical portion of the projectile.

The rotating band is forced through the rifling of the bore and gives rotation to the projectile. The rotating band also seals the grooves and prevents the escape of gas. When the rifling is worn, due to erosion, broader bands are necessary. Rotation is given to the projectile in order to prevent the projectile from tumbling end over end in the air. The rotation in our service is clockwise, as viewed from the base of the projectile. The base and fuse plugs are arranged to screw to the left, so that the rotation of the projectile to the right may have no tendency to unscrew them.

Coast artillery projectiles are cast iron or steel. The service projectiles are the armor-piercing shot, the armor-piercing shell, and the shrapnel. The shot has a thicker wall and contains a smaller bursting charge than the shell. For the uses of shot and shell, see paragraph 6. The shrapnel is a projectile which carries a number of bullets to a distance from the gun and there discharges them over an extended area.

743. **Racer.**—That part of a gun or mortar carriage which rests upon the traversing rollers. On gun carriages the chassis is bolted to the racer, and on mortar carriages the side frames are bolted to the racer.

744. **Ramp.**—An inclined plane serving as a means of travel from one level to another.

745. **Range.**—In a limited sense, the horizontal distance from the gun to the target. In a general sense, it is applied to horizontal distances between position finder and target, position finder and splash, gun and splash, etc. The range of a shot is the horizontal distance from the muzzle of the gun in the firing position to the point of splash. (Practically the range is reckoned from the axis of the gun trunnions in the firing position, instead of from the muzzle, but the difference in range is negligible.) The range used in ballistics is the horizontal distance from the muzzle of the gun in the firing position to the point of fall. (See fig. 15, par. 790.)

746. **Range-azimuth table.**—A table of ranges and the corresponding azimuths from a gun to points in the center of the main ship channel or channels. It is kept at the gun and used for firing without the use of range-finding apparatus.

747. **Range rake.**—An instrument used for determining shorts and overs. The camera record is used whenever practicable in preference to the range rake record.

748. **Range table.**—A table of the elements of the trajectory of a particular cannon for a standard muzzle velocity and a given projectile.

For direct fire guns, with the range as argument, are tabulated angle of departure; change in elevation for 10 yards in range; time of flight; angle of fall; slope of fall; maximum ordinate; striking velocity; perforation of Krupp armor at normal, and 30° from normal, impact; drift; and deflection for 10 miles per hour wind component. The ballistic coefficient used in calculating the table is shown.

For indirect fire cannon, with elevations and zones as arguments, are tabulated range; time of flight; drift; angle of fall; maximum ordinate; striking velocity; and perforation of deck steel.

749. **Rapid-fire gun.**—A single-barrel breech-loading gun provided with breech mechanism, mounting, and facilities for loading, aiming, and firing with great rapidity. The breech mechanism is operated by a single motion of the handle or lever. The smaller calibers use fixed ammunition.

750. **Rated men.**—Enlisted men who have passed examinations for the positions and who have been rated by the coast defense

commander as gun commanders, gun pointers, observers, plotters, casemate electricians, chief planters, and chief loaders. (See Appendix A.)

751. **Rear slope.**—The slope in rear to the battery parade.

752. **Receiving table.**—The hoist table on which projectiles are placed preparatory to raising.

753. **Recoil.**—The backward movement of the gun on firing. Counter recoil is the return of the gun in battery.

754. **Recoil cylinders.**—Hydraulic cylinders for controlling the recoil.

755. **Recoil buffers.**—Devices on gun carriages for the purpose of reducing the shock due to abnormally excessive recoil.

756. **Reference numbers.**—The numbers of the graduations of some scales of computing and correcting instruments employed in gunnery, their object being to avoid the liability to error that arises from the use of "right" and "left" in deflection corrections, and of "plus" and "minus" in range corrections.

757. **Relocation of a target.**—A process whereby the range and azimuth of a target from a point may be obtained without observation when the range and azimuth of the target is known from some other point.

758. **Rifling.**—Helical grooves cut in the surface of the bore for the purpose of giving a rotary motion to the projectile. The rib of metal between two adjacent grooves is called a "land." (See Twist of rifling.)

759. **Rimbases.**—The masses of metal uniting the trunnions of a cannon with the trunnion band.

760. **Round.**—The firing of a single load from each gun of a battery not simultaneously.

761. **Salvo.**—The simultaneous firing of a single load from each gun or mortar of a battery or from each mortar of a pit. The former is called a "battery salvo" and the latter a "pit salvo."

762. **Salvo point.**—A selected point on which a salvo from one or more batteries may be centered, the range and azimuth having been carefully determined.

763. **Salvo table.**—A table giving ranges and azimuths of salvo points.

764. **Serving table.**—A table for keeping a supply of projectiles (for the intermediate or minor armament) convenient to the breech during firing.

765. **Set-forward point.**—A point on the course of a target in advance of the plotted point at which it is estimated that a target will arrive, at the end of the predicting interval plus the time of flight for the range. It is located (on the plotting board) by laying off from the last plotted position of the target, along the estimated course of the target, a distance equal to the travel of the target during the predicting interval plus the time of flight.

766. **Shell.**—A projectile with a large cavity for explosive.

767. **Shell filler.**—An explosive used to make up the bursting charge in a projectile.

768. **Shell room or shot room.**—A room for the storage of projectiles.

769. **Shell tracer.**—A device attached to the base of a projectile which enables its flight to be followed. In the daytime a smoke (which is visible) is emitted and at night a bright flame.

770. **Shot.**—A projectile with a small cavity for explosive; also the firing of a single load from a single gun or mortar.

771. **Shot gallery.**—A gallery for the storage of projectiles.

772. **Shot hoist.**—A device for raising projectiles from the hoist room to the loading or truck platform. Sometimes called ammunition hoist.

773. **Shot hoist well.**—The shaft through which the projectile hoist operates.

774. **Shot tongs.**—A device used in lifting projectiles.

775. **Sight.**—A device by which the gun pointer gives the gun the proper direction for firing. Sights are of two classes, open and telescopic.

776. **Sight standard.**—The upright on the carriage which supports the sight.

777. **Splash, angle of.**—See Danger angle.

778. **Splash, point of.**—See Point of splash.

779. **Striking velocity.**—The velocity of the projectile at the point of impact.

780. **Subcaliber platform.**—A platform attached to a disappearing gun carriage for the support of the breech detail during subcaliber practice.

781. **Subcaliber tube.**—A small gun which is fitted in the bore of a gun of larger caliber.

782. **Superior slope.**—The top slope of a parapet or traverse.

783. **Swell of the muzzle.**—The enlargement of the exterior of a cannon at the muzzle.

784. **Targ.**—The piece of metal (or other material) used to indicate the intersection of the arms on the plotting board.

785. **Throttling bar.**—A bar in the recoil cylinder to regulate the size of the orifice through which the oil escapes from one side of the piston head to the other.

786. **Throttling pipe.**—A pipe connecting the rear ends of two recoil cylinders. The throttling and the equalizing pipes are joined by a connecting pipe through which oil flows from one end of the cylinders to the other without passing through the piston heads. The amount of oil which passes through the connecting pipe is controlled by the throttling valve. The recoil of the gun can be controlled to a certain extent by varying the setting of the throttling valve.

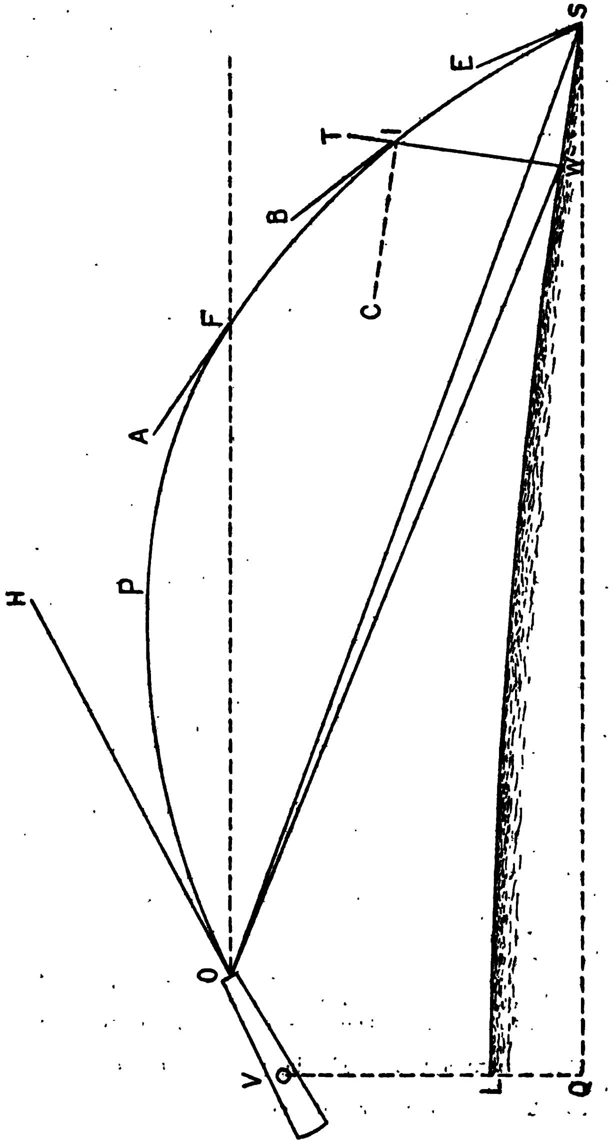
787. **Time interval bell or T. I. bell.**—A bell to indicate the observing interval. Bells ring simultaneously at the emplacements and the observing stations. They are operated by a clock or a motor.

788. **Time interval recorder.**—The ordinary stop watch.

789. **Top carriage.**—The top carriage is a part of the gun carriages for guns of 8-inch or greater caliber and for 6-inch guns mounted on disappearing carriages. It consists of the recoil cylinders, the axle bed side frames, and the connecting pipes and transoms.

790. **Trajectory.**—The curve described by the center of gravity of the projectile in passing from the muzzle of the gun to the point

FIG. 15.



of impact. The lateral travel of the projectile is not proportional to the range, and the trajectory is, therefore, in general, a curve of double curvature, convex to the plane of departure. The trajectory of the range tables ignores the deflecting forces, and lies in the plane of departure. Deflections due to wind and drift are considered separately. There is no appreciable error introduced by considering the trajectory as a plane curve lying in a vertical plane.

The "principle" of the rigidity of the trajectory assumes that the figure whose outline is composed of the trajectory and its chord, behaves as if it were cut out of cardboard and rotated up and down with the muzzle of the gun as a center. For example, in fig. 15, according to this principle, it is assumed that the shape of the trajectory is the same as if the point S were in the horizontal plane through the muzzle of the gun, and the angle ESO is equal to the angle of fall for a horizontal range equivalent to OS.

OPS = Trajectory.
F = Point of fall.
I = Point of impact.
S = Point of splash.
W = Center of target.
LV = Height of site.
OH = Line of departure.
OW = Line of direction.
AF = Line of fall.
BI = Line of impact.
OS = Chord of the trajectory.
QS = Range of shot.
TW = Target.
FOS = Angle of depression.
ESQ = Angle of splash—danger angle.
HOS = Angle of departure.
HOF = Quadrant angle of departure.
AFO = Angle of fall (range table) for horizontal range OF.
BIT = Angle of impact.
BIC = Angle of incidence.

791. Travel of projectile.—The distance from the base of the projectile in its seat to the face of the muzzle of the cannon.

792. Traverse.—The structure protecting the armament and personnel from flank fire.

793. Traverse slope or wall.—The side slope or wall of the traverse.

794. Traversing circle.—The metal which is bolted to the concrete and which supports the rear part of the carriage in the front pintle type. Traversing wheels roll on this circle.

795. Traversing rollers.—Rollers which rest upon the base ring and which enable the gun or mortar carriage to be given motion right or left.

796. Tripping.—The act of releasing the counterweights of a disappearing carriage, and thus causing the piece to go into its firing position.

797. Truck platform.—If the ammunition trucks run on a different surface from that of the loading platform, this surface is called the "truck platform."

798. Trunnions.—The cylinders which rest in bearing surfaces of the carriage called "trunnion beds." Their axis is perpendicular to the axis of the bore and ordinarily in the same plane; they connect the cannon with the carriage and transmit the force of recoil from one to the other. The faces of the trunnions are the end planes perpendicular to their axis.

799. Trunnion band.—The hoop of which the trunnions of a cannon form a part.

800. Tube.—The inner cylinder of a cannon.

801. Twist of rifling.—The inclination of the grooves to the axis of the gun at any point. When this inclination is constant the twist is uniform; when it increases from the breech to a point near the muzzle it is increasing. Twist is generally expressed in turns per caliber, e. g., one turn in 50 calibers, meaning that the projectile makes one complete rotation in passing over a distance equal to 50 calibers, provided the twist were uniform. In most of the major caliber guns in our service, the twist increases from one turn in 50 calibers to one turn in 25 calibers at a short distance from the muzzle and beyond that point it is uniform.

802. Velocity.—As used in coast artillery practice, velocity is the rate of travel of a projectile in feet per second. The velocity at the muzzle is the "initial" or "muzzle" velocity. The velocity at the point of impact is the "striking" velocity. The velocity at any point of the trajectory between the muzzle and the point of impact is the "remaining" velocity at that point.

803. Vent.—A small channel leading from the exterior of the cannon to the powder chamber for the ignition of the powder charge. It is an "axial vent" when it is in line with the axis of the bore. It is a "radial vent" when it is at right angles to the axis of the bore.

804. Zone.—In mortar firing, the area in which projectiles fall for a given charge of powder, when the elevation is varied between the minimum and maximum.

It is also used with reference to other divisions of the defensive area, as "outer defense zone," "inner defense zone," etc. See also Zone, 50 per cent.

805. Zone, 50 per cent (sometimes called probable zone).—The space bounded by two parallel lines within which 50 per cent of the points of impact of all shots fired with the same elevation and azimuth settings will probably lie. The width of the 50 per cent zone in any direction is equal to twice the probable error in that direction. The area common to the 50 per cent lateral zone and the 50 per cent longitudinal zone is the 25 per cent rectangle.

Appendix A.

EXAMINATION FOR GUNNERS AND FOR SPECIAL RATINGS.

EXAMINATION FOR GUNNERS.

806. Boards of examination will be convened annually in each coast defense command by the coast defense commander, to meet, if practicable, just prior to, or just after the close of the indoor instruction period. Separate boards may be convened for the examination of candidates for first and for second class gunners, and separate boards may be convened for the different forts in a coast defense command. Each board will consist of three coast artillery officers. When a member of the board is a company commander he will be relieved by another officer during the examination of candidates from his company.

807. For purposes of instruction and examination, enlisted men of the Coast Artillery Corps not belonging to companies or batteries, upon application, will be attached to convenient organizations, and upon qualification will be classified as gunners.

808. A candidate to be eligible for qualification as first-class gunner must have qualified previously as second-class gunner, though both qualifications may be made at the same examination.

809. The examination of gunner candidates will be held, as far as practicable, at such places as the material pertaining to the subject in hand is located, and will be made as practical as possible. In determining the qualifications of candidates, credit will be given for practical knowledge of subjects, rather than for text-book answers to questions.

810. The qualifying mark for classification as first or second class gunner will be in each case not less than an average of 75 per cent. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on subjects for which he has already been examined, increased by the maximum allowed for the remaining subjects, is less than 75, he will be disqualified and his examination will be discontinued. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on the subjects in which he has already been examined is 75 or more, he will be qualified without any further examination.

811. The board will keep a record of its marks during the examination, but these marks will not be published in orders. The report of the board on each company will be sent as soon as practicable after the completion of the examination to the coast defense commander, who will publish an order announcing the names of those who have qualified as first and second class gunners, and the date of qualification (the date of the completion of the company examination being taken as the date of qualification).

312. The scope of the examinations for the first and second class gunners and the relative weights to be given the subjects will be as follows:

For candidates in companies assigned to gun defense:

For second-class gunners:

(*a*) Service of the piece (practical). This will include an actual drill at the battery in which the candidate will in turn perform the duties of various numbered cannoneers, the range setter, the chief of breech, the elevation setter (mortars only), and the azimuth setter (mortars only), or as many of those duties as the board may direct	40
(*b*) Nomenclature of the various parts of the gun and carriage	5
(*c*) Action, adjustment, and care of the various parts of guns and carriages	20
(*d*) Powders, projectiles, primers, and fuses	10
(*e*) Cordage, gins, shears, and jacks	10
(*f*) United States magazine rifle	15
	100

For first-class gunners:

(*a*) The azimuth instrument (theoretical, 5; practical, 10)	15
(*b*) Duties in the plotting room (theoretical, 20; practical, 30). The candidate will act in turn as Nos. 1, 2, 3, 4, and 5 while tracking a moving target (if practicable), or in as many of those positions as the board may direct	50
(*c*) Aiming and laying guns or mortars, practical	15
(*d*) Time-range board (guns) and time-azimuth board (mortars), practical	10
(*e*) Definitions, C. A. D. R	5
(*f*) War ships, characteristic features	5
	100

The examination of candidates for first-class gunners of organizations assigned exclusively to rapid-fire guns not provided with separate position finding system will include the following head in lieu of those given under (*b*) and (*d*):

(*b*) (*d*) Subcaliber firing	60

The examination in subjects (*a*), (*b*), (*c*), and (*d*) for both second-class and first-class gunners will be confined to the matériel of that part of the defense to which the company is assigned. If no azimuth instrument is included in the battery equipment, the instrument used in the instruction will be used in the examination.

For candidates in companies and detachments assigned to mine defense:

For second-class gunners:

(*a*) Ammunition, nomenclature, and service of guns to which the candidate's company is assigned	15
(*b*) Material of and the duties in the loading room (except electrical principles involved)	30
(*c*) Material for and duties on the water	30
(*d*) Cordage, gins, shears, and jacks	10
(*e*) United States magazine rifle	15
	100

For first-class gunners:

(*a*) Care and preservation of mine material	15
(*b*) Handling high explosives	20
(*c*) Knowledge and use of the azimuth instrument and plotting board	20
(*d*) Engines, generators, transformers, storage batteries, and searchlights assigned to the company of which the candidate is a member	20
(*e*) Operation of casemate apparatus and of telephones	20
(*f*) Definitions C.A.D.R	5
	100

EXAMINATION FOR SPECIAL RATINGS.

813. In each company of coast artillery, examinations will be held by the company commander under the direction of the fire or mine commander, at such times as the latter may prescribe, for the purpose of determining enlisted men who are qualified for appointment to rated positions.

814. Records will be kept in each company in the form of eligible lists for each rated position to which enlisted men of the company may be appointed.

815. Examination for rated positions will be confined to first-class gunners or enlisted men who have once been classified as first-class gunners. Candidates who pass with an average of 75 per cent any of the examinations prescribed for rated enlisted men will be carried on the eligible list for appointment to the corresponding rated position for a period of three years from the date of examination.

816. Enlisted men on the eligible list for a rated position will be classified as first-class gunners from the date of qualification and so announced in coast defense orders, and such classification will be continued for the time they are entitled to remain on such eligible list. When a man's term of eligibility for any rated position expires he may be continued in such rated position or on the corresponding eligible list by passing a new examination for such rated position, and his classification as first-class gunner will be continued without further examination.

817. The same enlisted man may be carried on several eligible lists provided he passes satisfactorily the prescribed examinations for such rated positions.

818. Prior to the examination for the rated positions of observers, first or second class, or gun pointer, the candidates will be examined by the post surgeon for defective vision, and no candidate will be rated for these positions who has any defect in vision which would impair his efficiency.

819. An enlisted man holding a rated position need not be required to take the examination for that position until the termination of the three-year period from the date of his last classification as a first-class gunner, unless his qualifications for the position he holds have not been established to the satisfaction of the fire or mine commander concerned or the coast defense commander, in which case he will be required to take the examination for that position at such time as may be prescribed by the fire or mine commander concerned. In the event of his failure to pass satisfactorily the prescribed examination he will be disrated immediately by the coast defense commander.

820. The scope of the examination for each of the rated positions will be as follows:

GUN COMMANDER AND GUN POINTER.

I. Definitions C.A.D.R.

II. Gun and carriage.
  - (*a*) Nomenclature, purpose, and action of several parts.
  - (*b*) Packing stuffing boxes and cleaning recoil cylinders.
  - (*c*) Adjustment of—
    Quadrant elevation device, sight standard, throttling valve, gas check pad, elevating gear, grease cups, and firing mechanism.
  - (*d*) Care and preservation, including care of hand counterweights, oiling, and painting.

III. Powders, projectiles, fuses, and primers.
  - (*a*) Blending powder and preparation of powder charges.
  - (*b*) Filling and fusing projectiles.
  - (*c*) Painting projectiles.

IV. Preparations for service or subcaliber practice.

V. Service of the piece.
  - (*a*) Duties of each member of the gun section under all conditions.

VI. Precautions for safety at the battery.

VII. Pointing.
  - (*a*) Methods of pointing and pointing tests.
  - (*b*) The telescopic sight (the quadrant for mortars).
  - (*c*) Emergency system and salvo points.
  - (*d*) Bore sighting and orientation.

VIII. Regulations governing service and subcaliber practice so far as they affect the service at the emplacements.

IX. Mounting and dismounting guns and carriages.

X. Characteristic features of the several classes of warships general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

PLOTTER.

I. Definitions C. A. D. R.

II. Position finding system.
  - (*a*) Detailed knowledge of system employed at the battery.
  - (*b*) Indication and identification of targets.
  - (*c*) Duties of each member of the range section under all conditions.
  - (*d*) Emergency system and salvo points.

III. Position finding apparatus.
  - (*a*) A detailed knowledge of adjustments and use of all position finding apparatus used in the plotting room.

IV. Elementary gunnery.
  - (a) Explanation of the several corrections to be applied to the observed range to obtain the corrected range.
  - (b) Effect on the flight of the projectile of variations in the density of the air; the direction and velocity of the wind.
  - (c) Use of trial shots and application of data obtained from them (problem).

V. Preparation of target practice records.

OBSERVER (FIRST OR SECOND CLASS).

I. Definitions C. A. D. R..

II. Position finding system.
  - (a) Detailed description of that in use at the battery.
  - (b) Indication and identification of targets.
  - (c) Emergency system and salvo points.

III. Position finding apparatus.
  - (a) A detailed knowledge of adjustment and use of all observing instruments and range finders in use at the battery.
  - (b) Use of the telephone.

IV. Characteristic features of the several classes of warships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

CASEMATE ELECTRICIAN.

I. Definitions C. A. D. R.

II. Casemate apparatus.
  - (a) Nomenclature.
  - (b) Testing.
  - (c) Circuits.
  - (d) Maintenance.

III. Troubles and remedies.
  - (a) Lamps and bells.
  - (b) Switches.
  - (c) Ammeters and voltmeters.
  - (d) Telephones.
  - (e) Engines and machines.

CHIEF PLANTER.

I. Definitions C. A. D. R.

II. Mine planting material.
  - (a) Voltmeter test of a mine circuit.
  - (b) Hydraulic jacks.
  - (c) Nomenclature and use of apparatus aboard mine planters used in planting mines.
  - (d) Capacity of falls and winches.
  - (e) Automatic anchor.

III. Drill.
  - (*a*) Duties of noncommissioned officer on distribution box boat.
  - (*b*) Duties of noncommissioned officer in charge of planting mines from mine planter.
  - (*c*) Boat drill with yawl boat.

IV. Emergencies.

V. Cordage.

CHIEF LOADER.

I. Definitions C. A. D. R.

II. Explosives.
  - (*a*) Storage of explosives.
  - (*b*) Guncotton.
  - (*c*) Drying guncotton and guncotton primers.
  - (*d*) Preparation of guncotton primers from square cakes.
  - (*e*) Dynamite.
  - (*f*) Nitroglycerine.
  - (*g*) Evidence of free nitroglycerine in dynamite.
  - (*h*) Method of decomposing nitroglycerine to render it harmless.
  - (*i*) Preparation of priming charges.
  - (*j*) Trotol.

III. Fuses.
  - (*a*) Description.
  - (*b*) Tests.
  - (*c*) Storage of fuses.
  - (*d*) Preparation of fuses for loading plugs.

IV. Loading-room duties.
  - (*a*) Testing transformer and measuring the resistance of its circuits.
  - (*b*) Assembling and testing a compound plug.
  - (*c*) Loading a mine and preparing it for delivery to planter.

V. Unloading mines.
  - (*a*) Precautions.
  - (*b*) Returning charge to storage boxes.
  - (*c*) Determination of amount of water to add to guncotton.

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